BUTTERNUT ELECTRONICS CO.
405 E. Market Street Lockhart, Texas 78644 Phone: (512) 398-7117

MODEL HF6V

ASSEMBLY AND INSTALLATION INSTRUCTIONS

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PLEASE READ ALL INSTRUCTIONS THOROUGHLY BEFORE PROCEEDING TO ASSEMBLY. DURING ASSEMBLY AND INSTALLATION TAKE EXTREME CARE TO AVOID CONTACTING POWER LINES WITH ANY PART OF THE ANTENNA OR OTHER CONDUCTORS.

DO NOT INSTALL THE ANTENNA IN ANY PLACE WHERE ANY PART OF IT CAN COME INTO CONTACT WITH POWER LINES IN THE EVENT OF STRUCTURAL FAILURE OF ANY PART OF THE INSTALLATION OR IN THE COURSE OF NORMAL FLEXING AFTER INSTALLATION, FOR SUCH CONTACT CAN RESULT IN DAMAGE TO PROPERTY, BODILY INJURY OR EVEN DEATH!

IN NO CASE SHOULD THE ANTENNA BE INSTALLED IN ANY PLACE WHERE STRUCTURAL FAILURE OF ANY PART OF THE ANTENNA OR ITS SUPPORTING SYSTEM CAN ENDANGER PERSONS OR PROPERTY.

CAUTION! A GROUNDED ANTENNA WILL BE AT D.C. GROUND POTENTIAL! TO AVOID THE DANGER OF SHOCK CONNECT ALL STATION EQUIPMENT TO A GOOD EARTH GROUND. IT IS ALSO RECOMMENDED THAT ALL STATION EQUIPMENT BE DISCONNECTED FROM THE POWER MAINS BEFORE CONNECTING THE FEEDLINE TO THE ANTENNA. PLEASE CONSULT THE A.R.R.L HANDBOOK OR OTHER REFERENCE MANUALS FOR ADDITIONAL SAFETY PROCEDURES WHEN WORKING WITH ELECTRICAL EQUIPMENT.

Tools required for assembly: standard blade screwdriver, pliers, knife. A set of nutdrivers will be useful.

REFER TO THE APPROPRIATE DRAWINGS AND DIAGRAMS AND PROCEED AS FOLLOWS:

1. Check to be sure that all parts are present (see parts pictorial page).

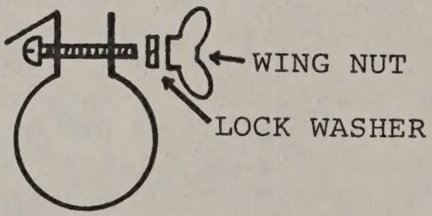
2. If the antenna is to be installed at ground level, plant mounting post A in a hole approximately 21 inches (55 cm.) deep so that the upper end of the fiber glass insulator rod is approximately 5 inches (12 cm.) above ground level. Pack earth tightly around the mounting post so that it will remain vertical. Concrete may be used in areas of high winds for greater strength, in which case the post may be twisted slightly during setting for easy removal later. The mounting post tube should be protected against corrosion if it is to be placed in concrete or in damp, acidic or alkaline soil. Asphalt roofing compound, polyurethane

varnish or any other sealant that protects against moisture may be used. No such protection is required for above-ground and most ground-level installations. NOTE: Hammering the mounting post into the earth may cause the insulator rod to splinter. If the post must be hammered into the earth, protect the end of the rod with a block of wood. If a permanent installation is not desired, a steel or other metallic tube having an inner diameter slightly larger than the outer diameter of section A (1-1/8 inches) may be used, and section A may be inserted into this outer tube for later removal. If the antenna is to be installed in an elevated position rather than at ground level, please refer to the note following step 19 below and to the separate roof mounting kit/radial information.

3. Prepare the impedance matching/d.c. grounding coil (Q) as shown in the pictorial.

4. Locate section B. This consists of two aluminum tubes, a long and a short one, joined by an insulating rod. The longer tube will later be mounted on the rod insulator at the top of section A. It is recommended that all subsequent steps involving section B be done indoors or in an area where dropped hardware may easily be recovered.

5. Locate the 80-40 meter coil assembly (C) and slide the clamp at the outer end of the larger coil over the short tubing end of section B, lowering the entire coil assembly until the middle clamp can be positioned around the fiber glass insulating rod. The middle clamp may have to be pulled open slightly to pass over the tubing and the bolt that goes through the upper tube and the insulator rod. Position the center coil clamp around the insulator rod so that the distance from the clamp to the end of either piece of tubing is approximately equal, and pass a #10 x 1" bolt through the holes of the center coil clamp as shown in the drawing immediately below. The outer tab of this clamp may be bent back slightly to provide clearance for the bolt, and it may be bent back into place after final assembly. Fasten the center coil clamp firmly in place using a split lockwasher and a wing nut. Repeat the procedure for the two remaining coil clamps, tightening the wing nuts only enough to hold the hardware in place. Coil adjustments will be made later.



COIL CLAMP DETAIL

6. Locate the 80-40 meter capacitors (installed on a flat strip

with a hole below the single capacitor. Install the shorter end of bracket (D) on this capacitor, using a #6 machine screw and lockwasher (see pictorial).

7. Line up the hole in (D) with the threaded end of the long #10 bolt protruding from the tab of the center coil clamp. Make sure that the long end of assembly (D) runs alongside the larger (80 meter) coil of assembly (C). Fasten (D) to the tab of the center coil clamp, using a flat washer, a split lockwasher and a #10 hex nut. Finally, fasten the small tab ends of assembly (D) firmly against the upper and lower tubes of (B) by means of the two large non-adjustable compression clamps. These clamps use a #8 x 1" bolt, a split lockwasher and a hex nut. If a flat blade screwdriver is used to tighten the clamps do not grasp the work immediately opposite the blade in order to avoid injury if the blade slips.

8. Locate tubing sections E, F, G, H, I and J as well as clamp and spacer assemblies M and N. Please note that as tubes are assembled the unslotted end of each tube will be pointing downward and the slotted ends will be pointing upward. Slide M over tube H and use the attached hardware to secure M at the approximate center of tube H; slide assembly N to the approximate center of tube G and secure with the attached hardware.

IN THE FOLLOWING STEPS TUBES E THROUGH I WILL BE FASTENED TOGETHER BY MEANS OF #8 HARDWARE (BOLT, SPLIT LOCKWASHER AND HEX NUT). AN 11/32" NUTDRIVER WOULD BE USEFUL BUT NOT NECESSARY. IF A FLAT BLADE SCREWDRIVER IS USED DO NOT HOLD THE WORK OPPOSITE TO THE BLADE IN ORDER TO AVOID POSSIBLE INJURY.

9. Insert the unslotted end of tube F into the slotted end of tube E, align the four holes, and pass a #8 x 1-1/4" bolt through both tubes. Place a split lockwasher and a hex nut on the threaded end of the bolt and tighten snugly.

10. Insert the unslotted end of tube G into the slotted end of tube F and proceed as in step 9, using a #8 x 1-1/4" bolt and hardware.

11. Insert the unslotted end of tube H into the slotted end of tube G and proceed as before, using a #8 x 1" bolt and hardware.

12. Insert tube I into tube H and proceed as before, using a #8 x 1" bolt and hardware.

13. Place the small gear-driven hose clamp over the slotted end

of tube I and tighten only enough to hold the hose clamp in place.

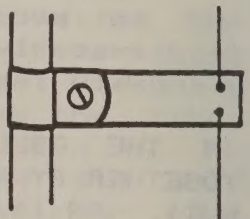
14. Slide the uncapped end of tube J into the slotted end of tube I until only 25 inches (63.5 cm.) extends from the end of tube I. Tighten the hose clamp snugly.

15. Locate clamp L and the attached length of stranded wire. Position clamp L around tube I so that its upper edge is approximately 8.5" (21.5 cm.) from the upper end of tube I. Pass a #8 x 3/4" bolt through the clamp holes and secure firmly with a split lockwasher and a hex nut.

16. Locate clamp K and position it around tube F. Pass a #8 x 3/4" bolt through the clamp holes. Finger tighten, using a split lockwasher and a hex nut. The plastic insulator strip should point upward.

17. Measure from the rivet of clamp L to a point that is 11 ft. 3 inches (3.43 m.) along the stranded wire. Mark this point for future reference.

18. Pass the free end of the stranded wire from clamp L downward through the small holes in spacers M and N as shown in the illustration to the right. M and N may be turned on their tubes so that they line up with clamp L. Loop the end of the wire through the hole in the plastic insulator of clamp K and slide clamp K along tube F until the mark on the wire appears at the small hole in the insulator. Wind the wire back on itself above the insulator to keep the excess out of the way. Do not cut off the excess wire.



19. Line up clamp K with clamp L and spacers M and N. Position clamp K so that the wire is moderately taut but not so tight as to cause the upper tubing sections to bow. This completes assembly of sections E through J. These may be set aside for later installation atop section B.

NOTE: In the following steps the antenna will be assembled and raised to its full vertical height, after which the 30 meter tuning circuit will be installed. If the antenna is to be installed in an elevated position (rooftop, mast, tower, etc.) where it is unsafe or inconvenient to make in-place adjustments, the antenna may have to be installed in one piece, in which case it will probably be necessary to raise and lower it and its supporting structure a number of times to arrive at the "ideal" adjustment on all bands. If so, every precaution should be observed in order to avoid possible contact with power lines and to prevent structural failure that can cause injury to persons or

property. DO NOT USE U-BOLTS TO ATTACH THE TUBULAR MOUNTING POST (SECTION A) TO A MAST, TOWER OR VENT PIPE OR OTHER SUCH SUPPORT, FOR U-BOLTS WILL EVENTUALLY CUT INTO THE TUBING AND WEAKEN THE INSTALLATION. If, however, U-bolts must be used, place a larger-diameter metal tube or other suitable protective material around the mounting post tube. Similar precautions should be observed when using TV-style towers with locking bolts. The Butternut Electronics roof mounting kit (model RMK-II) includes a protective sleeve for the mounting post tube, and this tube is also available separately as model MPS for non-permanent ground-level installations.

20. Place the lower end of section B over the rod insulator of section A and line up the screw holes. Pass a #8 x2" bolt through the holes. Secure with a #8 split lockwasher and hex nut.

21. AVOID POWER LINES! Raise assembly E through J and slide the lower end of E into the slotted end of section B. Align the holes through the two tubes and fasten securely, using a #8 x 1-1/2" bolt and hardware.

22. Locate tube O and 30 meter coil P (O is the short tube with an insulator at one end). Note that the upper end of P is connected to a double clamp assembly that includes a ceramic capacitor. Place a #10 split lockwasher and a wing nut on the bolt through the lower (single) clamp attached to coil P and tighten just enough to hold the hardware in place. Place a #10 lock washer and hex nut on the bolt through the upper clamp that is immediately connected to coil P and tighten just enough to hold the hardware in place. Locate the small "L"-shaped clamp shown in the drawing with O. Fasten this clamp to O by means of a #8 x 3/4" bolt, a split lockwasher and a hex nut.

23. Pass the lower clamp of coil P over the insulator end of tube O and slide the coil downward along the tube until the upper edge of the upper clamp is flush with the end of the insulator. Position the upper clamp so that the entire upper assembly points in the same direction as the "L"-shaped clamp at the bottom of tube O. Tighten the upper clamp securely around the insulator and set the completed O-P assembly aside.

24. From the center of the center clamp of coil assembly C, measure downward to a point that is 13" (33 cm.) along the lower tube of section B. Mark this point and stretch the 80 meter (larger) coil until the lower edge of the bottom clamp is even with the mark. Tighten the wing nut to secure the clamp at this point.

25. From the center of the center clamp of coil assembly C measure upward to a point 9-3/8" (24 cm.) along the upper

tube of section B. Mark this point and stretch the 40 meter (smaller) coil until the upper edge of the upper clamp is even with the mark. Tighten the wing nut to secure the clamp at this point.

26. Take up the assembled 30 meter unit (sections O and P) and position the remaining upper clamp around tube E so that the L-bracket clamp from the lower end of O is even with the fourth turn (counting from the top down) on the 40 meter coil on the upper tube of section B. Use a split lockwasher and a hex nut to tighten this clamp around tube E a slight amount.

27. Hook the L-bracket clamp from tube O around the fourth turn of the 40 meter coil and use small #8 hardware to tighten the clamp securely around the coil turn. Adjust the position of the larger clamp around tube E to avoid distorting the 40 meter coil. Tighten this clamp securely.

28. From the upper edge of the upper coil clamp on assembly P-O measure downward to a point 9-7/8" (25 cm.) along the aluminum tube. Mark this point and stretch the 30 meter coil until the lower edge of the lower clamp is even with this mark. Tighten the wing nut to secure the clamp at this setting. This completes the preliminary adjustment of the 80, 40 and 30 meter coils.

29. Install the 75-ohm matching line (R) on sections A and B as shown in the pictorial. Simply place the lugs over the ends of the #8 bolts at this time. The center conductor connects to section B, the braid to section A.

30. Place #8 flat washers over the lugs and install impedance-matching/d.c. grounding coil Q as shown. Point 1 should go to section B, point 2 to section A, and point 3 to any ground rod or other earth connection. Secure the connection to sections A and B with flat washers, lock washers and hex nuts. Radials or additional grounding may be attached to the connection on section A with the remaining #8 hardware.

31. MAKE SURE THAT THE STATION EQUIPMENT IS CONNECTED TO A GOOD EARTH GROUND! DO NOT HANDLE CABLE CONNECTED TO STATION EQUIPMENT WITHOUT FIRST DISCONNECTING THE EQUIPMENT FROM THE POWER MAINS. YOU COULD BE ELECTROCUTED!

Connect matching line R to any length of 50-53 ohm coaxial cable. A PL-258 "barrel" connector (S) is provided.

CHECKOUT AND ADJUSTMENT

The dimensions and coil settings given above should produce reasonably low VSWR readings over the entire 10, 15, 20 and 30

meter bands and over at least 250 kHz of the 40 meter band. Bandwidth on 80/75 meters should be at least 30 kHz for VSWR of 2:1 or less at the low end of the band and may be as much as 100 kHz at the high end of the band, depending on the efficiency of the ground system used, greater bandwidth being associated with lossy ground systems. It should be remembered that on those bands where the physical height of a vertical antenna is less than a quarter wavelength, the earth (or the resonant radial system in above-ground installations) will have a good deal to do with VSWR and antenna tuning, bandwidth and overall performance.

Low VSWR by itself does not mean that a vertical antenna is operating efficiently, and if low VSWR is obtained with no more than the usual "quick and dirty" ground connection, it most likely means the opposite. In general, poor operation or improper tuning of vertical antennas can usually be attributed to inadequate (or even reactive) ground systems or to other vertical conductors in the vicinity of the antenna. For these reasons it is suggested that the antenna be placed as much in the clear as possible and used with the best ground system that conditions permit. For a more complete discussion of the inter-relationships between vertical antenna efficiency, bandwidth, VSWR, etc., a standard text such as the A.R.R.L. Antenna Book is recommended. See also the material included at the end of these instructions.

For adjustment purposes a simple VSWR indicator may be used. More accurate measurements may be made at the antenna (i.e., at the junction of the 75-ohm matching line and the main transmission line) than at the input end of the line, but the tuning conditions that exist at the transmitter will usually be of greater interest in that one's principal concern will be to couple power from the transmitter into the transmission line.

1. Determine the frequency at which VSWR is lowest on 80/75 meters. The coil setting given earlier should produce resonance and lowest VSWR at approximately 3700 kHz. To raise the frequency of resonance and lowest VSWR, simply loosen the wing nut on the lower coil clamp of the lower (80 meter) coil on section B and stretch the coil a bit more. To lower the frequency, compress this coil. A one-inch change in the setting of this coil will produce a frequency shift of approximately 125 kHz. Remember that the antenna tunes very sharply in this range and that high values of VSWR may be encountered only a few kHz either side of the lowest VSWR readings, so it would be well to take VSWR readings every 25 kHz or so to avoid "running past" the frequency of resonance and lowest VSWR. To minimize interference to other stations and to avoid erroneous readings use only enough power to produce full-scale deflection of the meter in the "forward" or "r.f. out" position. Once the proper coil setting has been found for the desired band segment, coil Q at the base of the antenna

may be adjusted for even lower VSWR. If earth losses are moderate to high a good match may be possible if coil Q is left fully compressed; if earth losses are low (as with an extensive radial system) coil Q may have to be stretched to twice its compressed length or more for a good match. In any case, a single setting for coil Q should suffice for operation over most of 80/75 meters provided the 80 M coil is readjusted for each different band segment.

2. Determine the frequency of minimum VSWR on 40 meters. The coil setting given earlier should produce resonance and lowest VSWR at approximately 7150 kHz. The 40 meter VSWR and resonance curve may be shifted in the same manner as on 80/75 meters by changing the setting of the upper coil clamp on section B. On this band the setting is much less critical, and a one-inch change in the clamp setting will shift the VSWR curve approximately 80 kHz. Be sure to loosen the clamp around tube E that supports the 30 meter assembly and to reposition it as needed to avoid distorting the 40 meter coil.

3. Check VSWR on 20 meters. Tuning is quite broad on this band because the antenna is physically much taller than a quarter wavelength. To raise the frequency of lowest VSWR, reposition the 30 meter assembly so that the L-clamp can be replaced on the next-lower turn of the 40 meter coil (refer to step 27 in the assembly instructions). Alternatively, to lower the frequency of lowest SWR, reconnect the L-clamp to the next-higher turn of the 40 meter coil. In some cases, moving the tap point a full turn up or down may cause more of a frequency shift than is desired, in which case the entire 30 meter assembly may be rotated around tube E to permit adjustments of less than one full turn.

4. Check VSWR on 15 meters. The VSWR curve may be shifted upward or downward by changing the length of the stranded wire between clamps L and K. To raise the frequency, simply shorten the wire by wrapping a longer "tail" back on itself and sliding the lower clamp upward to maintain tension. To lower frequency, feed more of the "tail" back through the hole in the insulator to increase the length of the wire between clamps L and K. A change of 2 inches (5 cm.) will shift the VSWR curve approximately 300 kHz.

5. Check VSWR on 10 meters. To raise the resonant frequency loosen the small hose clamp over the slotted end of tube I and slide tube J farther into tube I; to lower the frequency, slide tube J farther out of tube I and retighten the hose clamp. A length change of 3 inches should move the VSWR curve approximately 200 kHz.

6. Check VSWR on 30 meters. To raise frequency, loosen the

wing nut on the bottom coil clamp of coil P, stretch the coil and retighten the wing nut. To lower frequency, compress the coil. A change of only 1/4" will shift the VSWR curve approximately 100 kHz. Large changes in the setting of coil P may affect 20 and 40 meter tuning, in which case it may be necessary to repeat steps 2 and 3. In general, the point at which the 30 meter coil taps on to the 40 meter coil will be the major factor in 20 meter tuning.

7. Adjustments for 40, 30, 20, 15 and 10 meters should have little or no effect on the previous adjustments for 80/75 meters, but a final VSWR check for this band should be made as in step 1 above.

8. In above-ground installations it will usually be found that resonance and lowest VSWR occur at slightly higher frequencies on all bands compared to ground-level installations. Therefore, on 15 and 10 meters, where length adjustment is the means of setting antenna resonance, it is recommeded that the length of the stranded-wire between clamps L and K be increased approximately 3 inches (7.5 cm.) and that tube J be extended approximately 6 inches (15 cm.) beyond the original dimensions given if an above-ground installation is contemplated. These are merely recommended preliminary settings, for it is impossible to indicate precise settings that will produce resonance or lowest VSWR at a given frequency in all installations.

In the preceding steps it has been assumed that the antenna has been installed in a more or less clear spot away from other vertical conductors such as TV antenna feedlines, towers and masts, and that a minimal ground system (or a system of resonant radials in the case of above-ground installations) has been installed. If these fairly basic conditions have not been met it is likely that resonance and low-VSWR will be impossible on some or even all bands. One should bear in mind that VSWR, even with a resonant antenna, will depend in large measure on local ground conductivity, height above ground in the case of an elevated antenna, the extent of the radial, counterpoise or other ground system used, and on other factors over which the operator may have little or no control. Fortunately, the evils of VSWR greater than unity have been grossly exaggerated in recent decades, and the only practical difference between a VSWR of unity and one of, say, 3:1 in the average case lies in the reluctance of modern equipment to deliver full power into lines operating at the higher VSWR without the help of a transmatch or other outboard matching device. Transmitters having so-called broadband solid-state output circuits (no tuning or loading controls) may be especially troublesome in this regard, whereas the older vacuum tube pi-network transmitters can usually be adjusted for maximum output over a tuning range where the VSWR does not exceed 2:1.

THEORY OF OPERATION

The HF6V operates as a slightly extended quarter-wave radiator on 15 meters, a quarter-wave stub decoupler providing practically lossless isolation of the upper half of the antenna on that band. On 20 meters the entire radiator operates as a 3/8-wave vertical with much higher radiation resistance and VSWR bandwidth than conventional or "trapped" antennas having a physical height of one quarter wave or less. On 10 meters the HF6V becomes a 3/4-wave radiator with considerably greater radiation resistance and efficiency than quarter-wave trapped types. On 40 and 80/75 meters the L-C circuits that provided the inductive reactance for resonance on those bands also provide the capacitive reactance required for resonance on 20 meters. On 30 meters, where the height of the HF6V is slightly greater than a quarter wavelength, an additional L-C series circuit effectively "shorts out" a portion of the 40 meter inductor to provide an additional resonance. In order to minimize conductor and I^2R losses on 80 and 40 meters where the antenna is physically shorter than a quarter wavelength and thus operates with lower values of radiation resistance, large-diameter self-supporting inductors and low-loss ceramic capacitors are employed. Because the 20 meter radiation resistance will be several times as great as that of conventional vertical antennas, an electrical quarter-wavelength section of 75-ohm cable is used as a "geometric mean" transformer to match the 100-odd ohms of feedpoint impedance on that band to a 50-ohm main transmission line of any convenient length.

ELECTRICAL AND MECHANICAL SPECIFICATIONS

Shipping weight: 12 lbs/5.4 kg.
Height (adjustable): 26 ft./7.8 m.
Feedpoint impedance: nominal 50 ohms with included matching section
VSWR at resonance: 1.5:1 or less all bands
Bandwidth for VSWR of 2:1 or less: entire 10, 15, 20, 30 meter bands; 250-300 kHz 40 meters, 30-90 kHz 80/75 meters
Power rating: 2KW PEP/1 KW c.w. 80/75, 40, 20, 15, 10 meters; 500 watts PEP/ 300 watts c.w. 30 meters
Wind loading area: 1.5 sq. ft./.15 sq. m.

GUYING

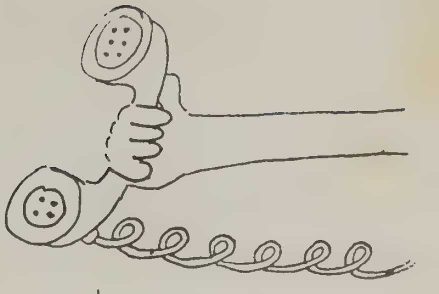
The HF6V is designed to survive winds of up to 80 m.p.h./125 k.p.h. without guying in the absence of ice loading or heavy precipitation, but over a period of time it is to be expected that frequent or even constant flexing or vibration will reduce the chances for survival in winds that would not damage a newly-installed antenna. Therefore, in areas of frequent or heavy winds a set of short non-conductive guys should be used to reduce the stresses that wind loading will impart to the lower sections of the antenna. In this connection, it should be noted that

light nylon twine is totally unsuitable as guying material because it has too much stretch per unit length, although the heavier sizes of nylon rope (or even sash cord) may be suitable if used in short runs. Polyethylene rope may be used, but because some grades tend to deteriorate fairly rapidly, periodic inspections should be made. A single set of guys placed just above the 30 meter circuit will contribute greatly to the stability and the longevity of the antenna, provided that the guys retain a slight amount of slack and do not come off at too steep an angle. At angles of less than 45° the guys begin to exert a downward compressive force on the structure that can be more of a threat to survival than lateral wind loading on an unguyed structure. Under no circumstances should guys be placed higher than one-third of the way up the antenna. The upper two-thirds of the HF6V has little more than its own weight to support, so these sections may be allowed to bend with the wind with no serious risk of damage. It is the lower third of the antenna that must support both the weight of the upper sections and the wind loading on them and are thus more likely to receive damage in severe winds.

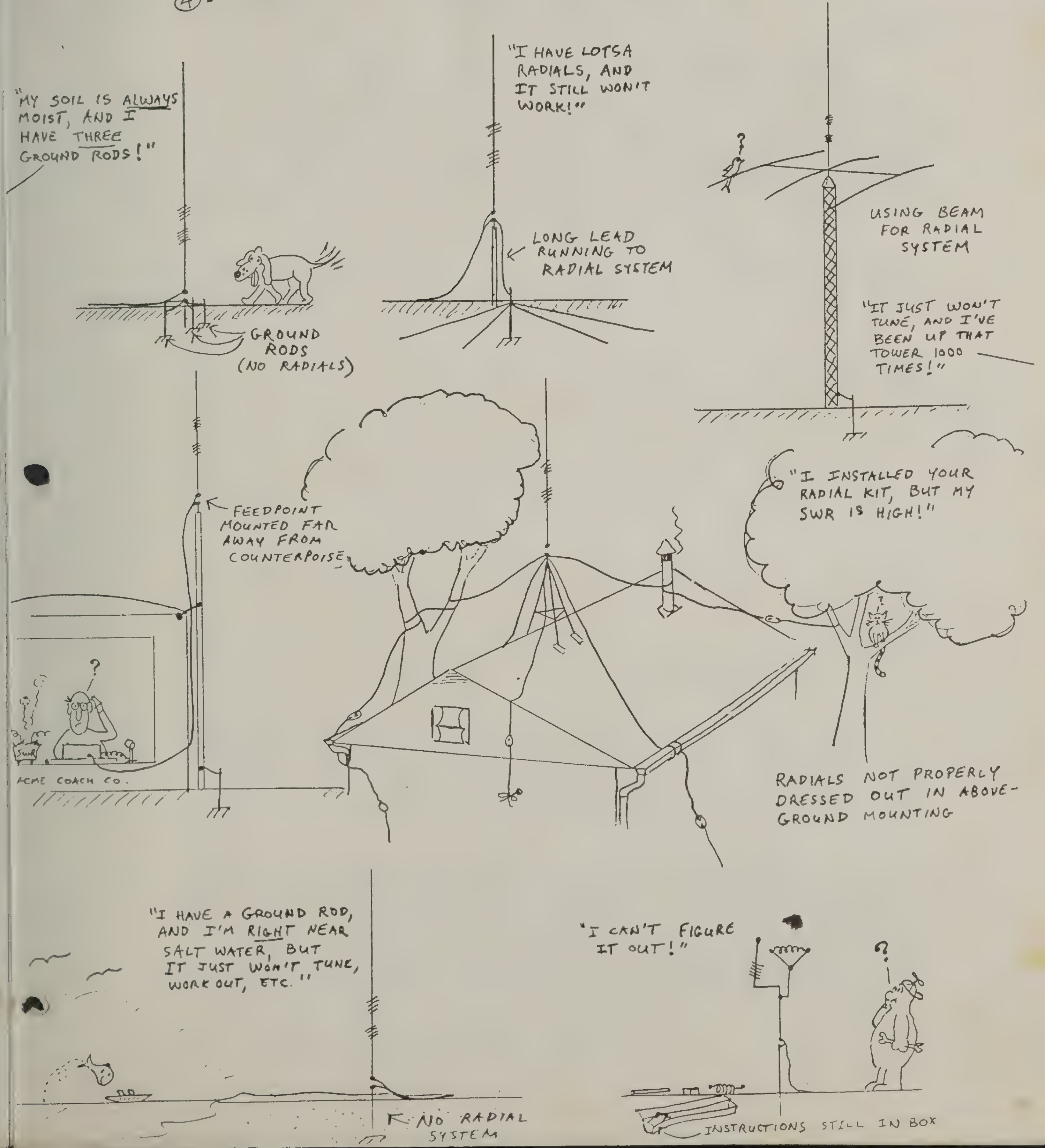
NOTE: A small packet of anti-seize/anti-oxide compound ("Butter-It's-Not"TM) will be found inside mounting post A. This compound should be applied lightly to each tubing joint and to the inside of all clamps that must make good electrical contact with the tubing sections.

A small roll of weatherproof sealing tape ("Konnektor-Kote"TM) is also provided. This may be used to seal the outside of the r.f. connectors that join the 75-ohm matching line (R) to the main transmission line for the antenna.

Before you call us



① FOLLOW THE INSTALLATION INSTRUCTIONS
② TUNE CAREFULLY & SYSTEMATICALLY
③ MAKE SWR CURVES
④ BE PREPARED TO DESCRIBE YOUR INSTALLATION


"MY SOIL IS ALWAYS MOIST, AND I HAVE THREE GROUND RODS!"
GROUND RODS (NO RADIALS)
"I HAVE LOTSA RADIALS, AND IT STILL WON'T WORK!"
LONG LEAD RUNNING TO RADIAL SYSTEM
?
USING BEAM FOR RADIAL SYSTEM
"IT JUST WON'T TUNE, AND I'VE BEEN UP THAT TOWER 1000 TIMES!"
FEEDPOINT MOUNTED FAR AWAY FROM COUNTERPOISE
?
SWR
ACME COACH CO.
"I INSTALLED YOUR RADIAL KIT, BUT MY SWR IS HIGH!"
?
RADIALS NOT PROPERLY DRESSED OUT IN ABOVE-GROUND MOUNTING
"I HAVE A GROUND ROD, AND I'M RIGHT NEAR SALT WATER, BUT IT JUST WON'T TUNE, WORK OUT, ETC."
NO RADIAL SYSTEM
"I CAN'T FIGURE IT OUT!"
?
INSTRUCTIONS STILL IN BOX

READ THIS FIRST!   READ THIS FIRST!   READ THIS FIRST!

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MODIFICATIONS: MODELS HF6V/HF6V-X--MARCH 1988

Because of size restrictions for shipments to APO, FPO and other foreign addresses the "standard" version of the HF6V is discontinued effective 1 March 1988. After that date only the HF6V-X model will be produced. There is no electrical difference between the "old" HF6V and the "new" HF6V-X, and the sole reason for the above change is to allow a shorter shipping container to be used in order to comply with parcel post regulations.

SPECIFIC MODIFICATIONS (SEE P. 13, PARTS AND PICTORIAL PAGE)--DISREGARD THOSE PARTS OF THE HF6V INSTRUCTIONS RELATING TO TUBING SIZE AND LENGTH.

1. The lower section of tube B has been shortened for packing and a 28-inch (71 cm.) length of 1-1/4 O.D. tubing has been provided for attachement to the lower end of tube B. This section is slotted at one end and a hose clamp has been provided to hold this section in place. Position it so that the distance from the lower end of this tube to the end of tube B is 4.0 ft. (121.9 cm.), and tighten the hose clamp. The lower end of this tube may then be attached to the insulator on section A according to the instructions.

2. An additional extension tube for the upper end of section B is also provided. This tube is 36 inches/91.44 cm. long and attaches to the glass-epoxy insulator rod at the top of section B. NOTE: the upper end of section B differs from section A in that the bolt through mounting tube A and its glass-epoxy insulator is longer to provide room for radials and the coaxial feedline. Do not confuse the two!

3. Tubing sections E2 through J are 3 ft. long, and an additional length of 1-inch diameter tubing (E1) is supplied. E2 telescopes over the smaller diameter tube extending from the upper end of tube E1 and is fastened to it by means of a #8 x 1-1/4 inch bolt, lockwasher and hex nut.

4. Clamp L should be attached along tube I so that the lower end of the wire coming down from clamp L is approximately 11 feet 3 inches (3.43 meters) above the antenna feedpoint. This length is also that of the braided wire in most above-ground installations. Placement of clamp L along tube I is not critical. See the instructions for adjustment of the twisted-wire stub for 15 meter resonance.

Additional hardware is included as needed.

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SPECIFIC MODIFICATIONS (SEE P. 13, PARTS AND PICTORIAL PAGE)--DISREGARD THOSE PARTS OF THE HF6V INSTRUCTIONS RELATING TO TUBING SIZE AND LENGTH.

1. The lower section of tube B has been shortened for packing and a 28-inch (71 cm.) length of 1-1/4 O.D. tubing has been provided for attachement to the lower end of tube B. This section is slotted at one end and a hose clamp has been provided to hold this section in place. Position it so that the distance from the lower end of this tube to the end of tube B is 4.0 ft. (121.9 cm.), and tighten the hose clamp. The lower end of this tube may then be attached to the insulator on section A according to the instructions.

2. An additional extension tube for the upper end of section B is also provided. This tube is 36 inches/91.44 cm. long and attaches to the glass-epoxy insulator rod at the top of section B. NOTE: the upper end of section B differs from section A in that the bolt through mounting tube A and its glass-epoxy insulator is longer to provide room for radials and the coaxial feedline. Do not confuse the two!

3. Tubing sections E2 through J are 3 ft. long, and an additional length of 1-inch diameter tubing (E1) is supplied. E2 telescopes over the smaller diameter tube extending from the upper end of tube E1 and is fastened to it by means of a #8 x 1-1/4 inch bolt, lockwasher and hex nut.

4. Clamp L should be attached along tube I so that the lower end of the wire coming down from clamp L is approximately 11 feet 3 inches (3.43 meters) above the antenna feedpoint. This length is also that of the braided wire in most above-ground installations. Placement of clamp L along tube I is not critical. See the instructions for adjustment of the twisted-wire stub for 15 meter resonance.

Additional hardware is included as needed.

BUTTERNUT ELECTRONICS CO.

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MODEL HF6V

ASSEMBLY AND INSTALLATION INSTRUCTIONS

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PLEASE READ ALL INSTRUCTIONS THOROUGHLY BEFORE PROCEEDING TO ASSEMBLY. DURING ASSEMBLY AND INSTALLATION TAKE EXTREME CARE TO AVOID CONTACTING POWER LINES WITH ANY PART OF THE ANTENNA OR OTHER CONDUCTORS.

DO NOT INSTALL THE ANTENNA IN ANY PLACE WHERE ANY PART OF IT CAN COME INTO CONTACT WITH POWER LINES IN THE EVENT OF STRUCTURAL FAILURE OF ANY PART OF THE INSTALLATION OR IN THE COURSE OF NORMAL FLEXING AFTER INSTALLATION, FOR SUCH CONTACT CAN RESULT IN DAMAGE TO PROPERTY, BODILY INJURY OR EVEN DEATH!

IN NO CASE SHOULD THE ANTENNA BE INSTALLED IN ANY PLACE WHERE STRUCTURAL FAILURE OF ANY PART OF THE ANTENNA OR ITS SUPPORTING SYSTEM CAN ENDANGER PERSONS OR PROPERTY.

CAUTION! A GROUNDED ANTENNA WILL BE AT D.C. GROUND POTENTIAL! TO AVOID THE DANGER OF SHOCK CONNECT ALL STATION EQUIPMENT TO A GOOD EARTH GROUND. IT IS ALSO RECOMMENDED THAT ALL STATION EQUIPMENT BE DISCONNECTED FROM THE POWER MAINS BEFORE CONNECTING THE FEEDLINE TO THE ANTENNA. PLEASE CONSULT THE A.R.R.L HANDBOOK OR OTHER REFERENCE MANUALS FOR ADDITIONAL SAFETY PROCEDURES WHEN WORKING WITH ELECTRICAL EQUIPMENT.

Tools required for assembly: standard blade screwdriver, pliers, knife. A set of nutdrivers will be useful.

REFER TO THE APPROPRIATE DRAWINGS AND DIAGRAMS AND PROCEED AS FOLLOWS:

1. Check to be sure that all parts are present (see parts pictorial page).

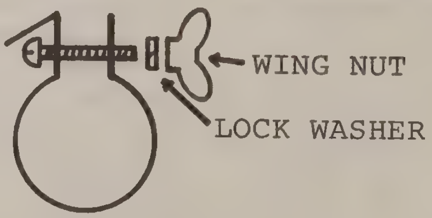
2. If the antenna is to be installed at ground level, plant mounting post A in a hole approximately 21 inches (55 cm.) deep so that the upper end of the fiber glass insulator rod is approximately 5 inches (12 cm.) above ground level. Pack earth tightly around the mounting post so that it will remain vertical. Concrete may be used in areas of high winds for greater strength, in which case the post may be twisted slightly during setting for easy removal later. The mounting post tube should be protected against corrosion if it is to be placed in concrete or in damp, acidic or alkaline soil. Asphalt roofing compound, polyurethane

varnish or any other sealant that protects against moisture may be used. No such protection is required for above-ground and most ground-level installations. NOTE: Hammering the mounting post into the earth may cause the insulator rod to splinter. If the post must be hammered into the earth, protect the end of the rod with a block of wood. If a permanent installation is not desired, a steel or other metallic tube having an inner diameter slightly larger than the outer diameter of section A (1-1/8 inches) may be used, and section A may be inserted into this outer tube for later removal. If the antenna is to be installed in an elevated position rather than at ground level, please refer to the note following step 19 below and to the separate roof mounting kit/radial information.

3. Prepare the impedance matching/d.c. grounding coil (Q) as shown in the pictorial.

4. Locate section B. This consists of two aluminum tubes, a long and a short one, joined by an insulating rod. The longer tube will later be mounted on the rod insulator at the top of section A. It is recommended that all subsequent steps involving section B be done indoors or in an area where dropped hardware may easily be recovered.

5. Locate the 80-40 meter coil assembly (C) and slide the clamp at the outer end of the larger coil over the short tubing end of section B, lowering the entire coil assembly until the middle clamp can be positioned around the fiber glass insulating rod. The middle clamp may have to be pulled open slightly to pass over the tubing and the bolt that goes through the upper tube and the insulator rod. Position the center coil clamp around the insulator rod so that the distance from the clamp to the end of either piece of tubing is approximately equal, and pass a #10 x 1" bolt through the holes of the center coil clamp as shown in the drawing immediately below. The outer tab of this clamp may be bent back slightly to provide clearance for the bolt, and it may be bent back into place after final assembly. Fasten the center coil clamp firmly in place using a split lockwasher and a wing nut. Repeat the procedure for the two remaining coil clamps, tightening the wing nuts only enough to hold the hardware in place. Coil adjustments will be made later.



COIL CLAMP DETAIL

6. Locate the 80-40 meter capacitors (installed on a flat strip

with a hole below the single capacitor. Install the shorter end of bracket (D) on this capacitor, using a #6 machine screw and lockwasher (see pictorial).

7. Line up the hole in (D) with the threaded end of the long #10 bolt protruding from the tab of the center coil clamp. Make sure that the long end of assembly (D) runs alongside the larger (80 meter) coil of assembly (C). Fasten (D) to the tab of the center coil clamp, using a flat washer, a split lockwasher and a #10 hex nut. Finally, fasten the small tab ends of assembly (D) firmly against the upper and lower tubes of (B) by means of the two large non-adjustable compression clamps. These clamps use a #8 x 1" bolt, a split lockwasher and a hex nut. If a flat blade screwdriver is used to tighten the clamps do not grasp the work immediately opposite the blade in order to avoid injury if the blade slips.

8. Locate tubing sections E, F, G, H, I and J as well as clamp and spacer assemblies M and N. Please note that as tubes are assembled the unslotted end of each tube will be pointing downward and the slotted ends will be pointing upward. Slide M over tube H and use the attached hardware to secure M at the approximate center of tube H; slide assembly N to the approximate center of tube G and secure with the attached hardware.

IN THE FOLLOWING STEPS TUBES E THROUGH I WILL BE FASTENED TOGETHER BY MEANS OF #8 HARDWARE (BOLT, SPLIT LOCKWASHER AND HEX NUT). AN 11/32" NUTDRIVER WOULD BE USEFUL BUT NOT NECESSARY. IF A FLAT BLADE SCREWDRIVER IS USED DO NOT HOLD THE WORK OPPOSITE TO THE BLADE IN ORDER TO AVOID POSSIBLE INJURY.

9. Insert the unslotted end of tube F into the slotted end of tube E, align the four holes, and pass a #8 x 1-1/4" bolt through both tubes. Place a split lockwasher and a hex nut on the threaded end of the bolt and tighten snugly.

10. Insert the unslotted end of tube G into the slotted end of tube F and proceed as in step 9, using a #8 x 1-1/4" bolt and hardware.

11. Insert the unslotted end of tube H into the slotted end of tube G and proceed as before, using a #8 x 1" bolt and hardware.

12. Insert tube I into tube H and proceed as before, using a #8 x 1" bolt and hardware.

13. Place the small gear-driven hose clamp over the slotted end

of tube I and tighten only enough to hold the hose clamp in place.

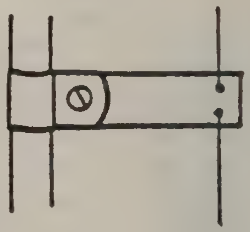
14. Slide the uncapped end of tube J into the slotted end of tube I until only 25 inches (63.5 cm.) extends from the end of tube I. Tighten the hose clamp snugly.

15. Locate clamp L and the attached length of stranded wire. Position clamp L around tube I so that its upper edge is approximately 8.5" (21.5 cm.) from the upper end of tube I. Pass a #8 x 3/4" bolt through the clamp holes and secure firmly with a split lockwasher and a hex nut.

16. Locate clamp K and position it around tube F. Pass a #8 x 3/4" bolt through the clamp holes. Finger tighten, using a split lockwasher and a hex nut. The plastic insulator strip should point upward.

17. Measure from the rivet of clamp L to a point that is 11 ft. 3 inches (3.43 m.) along the stranded wire. Mark this point for future reference.

18. Pass the free end of the stranded wire from clamp L downward through the small holes in spacers M and N as shown in the illustration to the right. M and N may be turned on their tubes so that they line up with clamp L. Loop the end of the wire through the hole in the plastic insulator of clamp K and slide clamp K along tube F until the mark on the wire appears at the small hole in the insulator. Wind the wire back on itself above the insulator to keep the excess out of the way. Do not cut off the excess wire.



19. Line up clamp K with clamp L and spacers M and N. Position clamp K so that the wire is moderately taut but not so tight as to cause the upper tubing sections to bow. This completes assembly of sections E through J. These may be set aside for later installation atop section B.

NOTE: In the following steps the antenna will be assembled and raised to its full vertical height, after which the 30 meter tuning circuit will be installed. If the antenna is to be installed in an elevated position (rooftop, mast, tower, etc.) where it is unsafe or inconvenient to make in-place adjustments, the antenna may have to be installed in one piece, in which case it will probably be necessary to raise and lower it and its supporting structure a number of times to arrive at the "ideal" adjustment on all bands. If so, every precaution should be observed in order to avoid possible contact with power lines and to prevent structural failure that can cause injury to persons or

property. DO NOT USE U-BOLTS TO ATTACH THE TUBULAR MOUNTING POST (SECTION A) TO A MAST, TOWER OR VENT PIPE OR OTHER SUCH SUPPORT, FOR U-BOLTS WILL EVENTUALLY CUT INTO THE TUBING AND WEAKEN THE INSTALLATION. If, however, U-bolts must be used, place a larger-diameter metal tube or other suitable protective material around the mounting post tube. Similar precautions should be observed when using TV-style towers with locking bolts. The Butternut Electronics roof mounting kit (model RMK-II) includes a protective sleeve for the mounting post tube, and this tube is also available separately as model MPS for non-permanent ground-level installations.

20. Place the lower end of section B over the rod insulator of section A and line up the screw holes. Pass a #8 x2" bolt through the holes. Secure with a #8 split lockwasher and hex nut.

21. AVOID POWER LINES! Raise assembly E through J and slide the lower end of E into the slotted end of section B. Align the holes through the two tubes and fasten securely, using a #8 x 1-1/2" bolt and hardware.

✓ 22. Locate tube O and 30 meter coil P (O is the short tube with an insulator at one end). Note that the upper end of P is connected to a double clamp assembly that includes a ceramic capacitor. Place a #10 split lockwasher and a wing nut on the bolt through the lower (single) clamp attached to coil P and tighten just enough to hold the hardware in place. Place a #10 lock washer and hex nut on the bolt through the upper clamp that is immediately connected to coil P and tighten just enough to hold the hardware in place. Locate the small "L"-shaped clamp shown in the drawing with O. Fasten this clamp to O by means of a #8 x 3/4" bolt, a split lockwasher and a hex nut.

✓ 23. Pass the lower clamp of coil P over the insulator end of tube O and slide the coil downward along the tube until the upper edge of the upper clamp is flush with the end of the insulator. Position the upper clamp so that the entire upper assembly points in the same direction as the "L"-shaped clamp at the bottom of tube O. Tighten the upper clamp securely around the insulator and set the completed O-P assembly aside.

HERE →

✓ 24. From the center of the center clamp of coil assembly C, measure downward to a point that is 13" (33 cm.) along the lower tube of section B. Mark this point and stretch the 80 meter (larger) coil until the lower edge of the bottom clamp is even with the mark. Tighten the wing nut to secure the clamp at this point.

✓ 25. From the center of the center clamp of coil assembly C measure upward to a point 9-3/8" (24 cm.) along the upper

tube of section B. Mark this point and stretch the 40 meter (smaller) coil until the upper edge of the upper clamp is even with the mark. Tighten the wing nut to secure the clamp at this point.

✓ 26. Take up the assembled 30 meter unit (sections O and P) and position the remaining upper clamp around tube E so that the L-bracket clamp from the lower end of O is even with the fourth turn (counting from the top down) on the 40 meter coil on the upper tube of section B. Use a split lockwasher and a hex nut to tighten this clamp around tube E a slight amount.

✓ 27. Hook the L-bracket clamp from tube O around the fourth turn of the 40 meter coil and use small #8 hardware to tighten the clamp securely around the coil turn. Adjust the position of the larger clamp around tube E to avoid distorting the 40 meter coil. Tighten this clamp securely.

✓ 28. From the upper edge of the upper coil clamp on assembly P-O measure downward to a point 9-7/8" (25 cm.) along the aluminum tube. Mark this point and stretch the 30 meter coil until the lower edge of the lower clamp is even with this mark. Tighten the wing nut to secure the clamp at this setting. This completes the preliminary adjustment of the 80, 40 and 30 meter coils.

29. Install the 75-ohm matching line (R) on sections A and B as shown in the pictorial. Simply place the lugs over the ends of the #8 bolts at this time. The center conductor connects to section B, the braid to section A.

30. Place #8 flat washers over the lugs and install impedance-matching/d.c. grounding coil Q as shown. Point 1 should go to section B, point 2 to section A, and point 3 to any ground rod or other earth connection. Secure the connection to sections A and B with flat washers, lock washers and hex nuts. Radials or additional grounding may be attached to the connection on section A with the remaining #8 hardware.

31. MAKE SURE THAT THE STATION EQUIPMENT IS CONNECTED TO A GOOD EARTH GROUND! DO NOT HANDLE CABLE CONNECTED TO STATION EQUIPMENT WITHOUT FIRST DISCONNECTING THE EQUIPMENT FROM THE POWER MAINS. YOU COULD BE ELECTROCUTED!

Connect matching line R to any length of 50-53 ohm coaxial cable. A PL-258 "barrel" connector (S) is provided.

CHECKOUT AND ADJUSTMENT

The dimensions and coil settings given above should produce reasonably low VSWR readings over the entire 10, 15, 20 and 30

meter bands and over at least 250 kHz of the 40 meter band. Bandwidth on 80/75 meters should be at least 30 kHz for VSWR of 2:1 or less at the low end of the band and may be as much as 100 kHz at the high end of the band, depending on the efficiency of the ground system used, greater bandwidth being associated with lossy ground systems. It should be remembered that on those bands where the physical height of a vertical antenna is less than a quarter wavelength, the earth (or the resonant radial system in above-ground installations) will have a good deal to do with VSWR and antenna tuning, bandwidth and overall performance.

Low VSWR by itself does not mean that a vertical antenna is operating efficiently, and if low VSWR is obtained with no more than the usual "quick and dirty" ground connection, it most likely means the opposite. In general, poor operation or improper tuning of vertical antennas can usually be attributed to inadequate (or even reactive) ground systems or to other vertical conductors in the vicinity of the antenna. For these reasons it is suggested that the antenna be placed as much in the clear as possible and used with the best ground system that conditions permit. For a more complete discussion of the inter-relationships between vertical antenna efficiency, bandwidth, VSWR, etc., a standard text such as the A.R.R.L. Antenna Book is recommended. See also the material included at the end of these instructions.

For adjustment purposes a simple VSWR indicator may be used. More accurate measurements may be made at the antenna (i.e., at the junction of the 75-ohm matching line and the main transmission line) than at the input end of the line, but the tuning conditions that exist at the transmitter will usually be of greater interest in that one's principal concern will be to couple power from the transmitter into the transmission line.

1. Determine the frequency at which VSWR is lowest on 80/75 meters. The coil setting given earlier should produce resonance and lowest VSWR at approximately 3700 kHz. To raise the frequency of resonance and lowest VSWR, simply loosen the wing nut on the lower coil clamp of the lower (80 meter) coil on section B and stretch the coil a bit more. To lower the frequency, compress this coil. A one-inch change in the setting of this coil will produce a frequency shift of approximately 125 kHz. Remember that the antenna tunes very sharply in this range and that high values of VSWR may be encountered only a few kHz either side of the lowest VSWR readings, so it would be well to take VSWR readings every 25 kHz or so to avoid "running past" the frequency of resonance and lowest VSWR. To minimize interference to other stations and to avoid erroneous readings use only enough power to produce full-scale deflection of the meter in the "forward" or "r.f. out" position. Once the proper coil setting has been found for the desired band segment, coil Q at the base of the antenna

may be adjusted for even lower VSWR. If earth losses are moderate to high a good match may be possible if coil Q is left fully compressed; if earth losses are low (as with an extensive radial system) coil Q may have to be stretched to twice its compressed length or more for a good match. In any case, a single setting for coil Q should suffice for operation over most of 80/75 meters provided the 80 M coil is readjusted for each different band segment.

2. Determine the frequency of minimum VSWR on 40 meters. The coil setting given earlier should produce resonance and lowest VSWR at approximately 7150 kHz. The 40 meter VSWR and resonance curve may be shifted in the same manner as on 80/75 meters by changing the setting of the upper coil clamp on section B. On this band the setting is much less critical, and a one-inch change in the clamp setting will shift the VSWR curve approximately 80 kHz. Be sure to loosen the clamp around tube E that supports the 30 meter assembly and to reposition it as needed to avoid distorting the 40 meter coil.

3. Check VSWR on 20 meters. Tuning is quite broad on this band because the antenna is physically much taller than a quarter wavelength. To raise the frequency of lowest VSWR, reposition the 30 meter assembly so that the L-clamp can be replaced on the next-lower turn of the 40 meter coil (refer to step 27 in the assembly instructions). Alternatively, to lower the frequency of lowest SWR, reconnect the L-clamp to the next-higher turn of the 40 meter coil. In some cases, moving the tap point a full turn up or down may cause more of a frequency shift than is desired, in which case the entire 30 meter assembly may be rotated around tube E to permit adjustments of less than one full turn.

4. Check VSWR on 15 meters. The VSWR curve may be shifted upward or downward by changing the length of the stranded wire between clamps L and K. To raise the frequency, simply shorten the wire by wrapping a longer "tail" back on itself and sliding the lower clamp upward to maintain tension. To lower frequency, feed more of the "tail" back through the hole in the insulator to increase the length of the wire between clamps L and K. A change of 2 inches (5 cm.) will shift the VSWR curve approximately 300 kHz.

5. Check VSWR on 10 meters. To raise the resonant frequency loosen the small hose clamp over the slotted end of tube I and slide tube J farther into tube I; to lower the frequency, slide tube J farther out of tube I and retighten the hose clamp. A length change of 3 inches should move the VSWR curve approximately 200 kHz.

6. Check VSWR on 30 meters. To raise frequency, loosen the

wing nut on the bottom coil clamp of coil P, stretch the coil and retighten the wing nut. To lower frequency, compress the coil. A change of only 1/4" will shift the VSWR curve approximately 100 kHz. Large changes in the setting of coil P may affect 20 and 40 meter tuning, in which case it may be necessary to repeat steps 2 and 3. In general, the point at which the 30 meter coil taps on to the 40 meter coil will be the major factor in 20 meter tuning.

7. Adjustments for 40, 30, 20, 15 and 10 meters should have little or no effect on the previous adjustments for 80/75 meters, but a final VSWR check for this band should be made as in step 1 above.

8. In above-ground installations it will usually be found that resonance and lowest VSWR occur at slightly higher frequencies on all bands compared to ground-level installations. Therefore, on 15 and 10 meters, where length adjustment is the means of setting antenna resonance, it is recommeded that the length of the stranded-wire between clamps L and K be increased approximately 3 inches (7.5 cm.) and that tube J be extended approximately 6 inches (15 cm.) beyond the original dimensions given if an above-ground installation is contemplated. These are merely recommended preliminary settings, for it is impossible to indicate precise settings that will produce resonance or lowest VSWR at a given frequency in all installations.

In the preceding steps it has been assumed that the antenna has been installed in a more or less clear spot away from other vertical conductors such as TV antenna feedlines, towers and masts, and that a minimal ground system (or a system of resonant radials in the case of above-ground installations) has been installed. If these fairly basic conditions have not been met it is likely that resonance and low-VSWR will be impossible on some or even all bands. One should bear in mind that VSWR, even with a resonant antenna, will depend in large measure on local ground conductivity, height above ground in the case of an elevated antenna, the extent of the radial, counterpoise or other ground system used, and on other factors over which the operator may have little or no control. Fortunately, the evils of VSWR greater than unity have been grossly exaggerated in recent decades, and the only practical difference between a VSWR of unity and one of, say, 3:1 in the average case lies in the reluctance of modern equipment to deliver full power into lines operating at the higher VSWR without the help of a transmatch or other outboard matching device. Transmitters having so-called broadband solid-state output circuits (no tuning or loading controls) may be especially troublesome in this regard, whereas the older vacuum tube pi-network transmitters can usually be adjusted for maximum output over a tuning range where the VSWR does not exceed 2:1.

THEORY OF OPERATION

The HF6V operates as a slightly extended quarter-wave radiator on 15 meters, a quarter-wave stub decoupler providing practically lossless isolation of the upper half of the antenna on that band. On 20 meters the entire radiator operates as a 3/8-wave vertical with much higher radiation resistance and VSWR bandwidth than conventional or "trapped" antennas having a physical height of one quarter wave or less. On 10 meters the HF6V becomes a 3/4-wave radiator with considerably greater radiation resistance and efficiency than quarter-wave trapped types. On 40 and 80/75 meters the L-C circuits that provided the inductive reactance for resonance on those bands also provide the capacitive reactance required for resonance on 20 meters. On 30 meters, where the height of the HF6V is slightly greater than a quarter wavelength, an additional L-C series circuit effectively "shorts out" a portion of the 40 meter inductor to provide an additional resonance. In order to minimize conductor and I^2R losses on 80 and 40 meters where the antenna is physically shorter than a quarter wavelength and thus operates with lower values of radiation resistance, large-diameter self-supporting inductors and low-loss ceramic capacitors are employed. Because the 20 meter radiation resistance will be several times as great as that of conventional vertical antennas, an electrical quarter-wavelength section of 75-ohm cable is used as a "geometric mean" transformer to match the 100-odd ohms of feedpoint impedance on that band to a 50-ohm main transmission line of any convenient length.

ELECTRICAL AND MECHANICAL SPECIFICATIONS

Shipping weight: 12 lbs/5.4 kg.
Height (adjustable): 26 ft./7.8 m.
Feedpoint impedance: nominal 50 ohms with included matching section
VSWR at resonance: 1.5:1 or less all bands
Bandwidth for VSWR of 2:1 or less: entire 10, 15, 20, 30 meter bands; 250-300 kHz 40 meters, 30-90 kHz 80/75 meters
Power rating: 2KW PEP/1 KW c.w. 80/75, 40, 20, 15, 10 meters; 500 watts PEP/ 300 watts c.w. 30 meters
Wind loading area: 1.5 sq. ft./.15 sq. m.

GUYING

The HF6V is designed to survive winds of up to 80 m.p.h./125 k.p.h. without guying in the absence of ice loading or heavy precipitation, but over a period of time it is to be expected that frequent or even constant flexing or vibration will reduce the chances for survival in winds that would not damage a newly-installed antenna. Therefore, in areas of frequent or heavy winds a set of short non-conductive guys should be used to reduce the stresses that wind loading will impart to the lower sections of the antenna. In this connection, it should be noted that

light nylon twine is totally unsuitable as guying material because it has too much stretch per unit length, although the heavier sizes of nylon rope (or even sash cord) may be suitable if used in short runs. Polyethylene rope may be used, but because some grades tend to deteriorate fairly rapidly, periodic inspections should be made. A single set of guys placed just above the 30 meter circuit will contribute greatly to the stability and the longevity of the antenna, provided that the guys retain a slight amount of slack and do not come off at too steep an angle. At angles of less than 45° the guys begin to exert a downward compressive force on the structure that can be more of a threat to survival than lateral wind loading on an unguyed structure. Under no circumstances should guys be placed higher than one-third of the way up the antenna. The upper two-thirds of the HF6V has little more than its own weight to support, so these sections may be allowed to bend with the wind with no serious risk of damage. It is the lower third of the antenna that must support both the weight of the upper sections and the wind loading on them and are thus more likely to receive damage in severe winds.

NOTE: A small packet of anti-seize/anti-oxide compound ("Butter-It's-Not"TM) will be found inside mounting post A. This compound should be applied lightly to each tubing joint and to the inside of all clamps that must make good electrical contact with the tubing sections.

A small roll of weatherproof sealing tape ("Konnektor-Kote"TM) is also provided. This may be used to seal the outside of the r.f. connectors that join the 75-ohm matching line (R) to the main transmission line for the antenna.

NOTES ON GROUND/RADIAL SYSTEMS FOR VERTICAL ANTENNAS

GROUND MOUNTING:

A vertical antenna in its simplest form is electrically equivalent to one-half of a dipole antenna stood on end. When the antenna is mounted close to the ground, the earth below takes the place of the "missing" half of the dipole. If ground conductivity is fair to good, a short metal stake or rod may provide a sufficiently good ground connection for resonant and low SWR operation on the bands for which the antenna is designed. This basic arrangement is shown in figure one. In almost every case, however, the efficiency of a vertical antenna will be greater if radial wires are used to improve ground conductivity as in figure two. Wire size is unimportant, and, in most ground-mounted installations, the radials may be any convenient length. They need not all be the same length, nor do they all need to be laid in a straight line. It is generally more convenient to slit the sod and to push the radials into the slits to a depth of several inches, but they may be left on the surface of the ground if they do not constitute a hazard. A large number of long radials will naturally be more effective in reducing ground losses than a small number of shorter ones, but one should remember that the greatest loss will occur in the earth near the base of the antenna where current flow is greatest. For this reason, it is generally better to use a larger number of radials of shorter length than a smaller number of longer ones for a given amount of wire.

In some cases wire mesh (e.g., "chicken wire") may be used as a substitute for radial wires and/or a ground connection, the mesh or screen acting as one plate of a capacitor to provide coupling to the earth beneath the antenna.

It should be noted that A GROUND ROD IS USEFUL ONLY AS A DC GROUND OR AS A TIE POINT FOR RADIALS. IT DOES NOTHING TO REDUCE RF GROUND LOSSES, REGARDLESS OF HOW FAR IT GOES INTO THE GROUND!

ABOVE GROUND MOUNTING:

It is possible to operate a vertical antenna at any height above ground provided that something be done to supply the equivalent of a ground connection. It is NOT ENOUGH TO RUN A LONG LEAD TO A GROUND STAKE OR COLD WATER PIPE, for current will flow in the lead, making it part of the overall antenna length and detuning the antenna on one or more bands. The usual approach to this problem is to install 3 or 4 resonant quarter-wave radials at the base of an elevated vertical and to connect them to the braid of the coaxial feedline as well as to the supporting mast or tower (if metal). Unlike the ground-mounted case, the length of above-ground radials is important, and the proper length(s) for any band may be found from the formula:

$$\text{Length (ft.)} = \frac{240}{\text{Frequency in Mhz}}$$

Four such radials, equally spaced, would be the equivalent of a highly conductive ground plane for any band at antenna base heights of one-half wavelength or more. In addition to providing a ground plane, radials of the proper length act as decoupling stubs to choke off current flow on any DC ground lead or grounded mast or tower, thus eliminating the detuning effect noted above. The basic ground plane system is shown in figure three. Radials may be run parallel to the earth or sloped downward any convenient amount without seriously affecting antenna feedpoint impedance or performance. Figure four shows a multi- band system using a separate set of radials for 40, 20, and 10 meters. Inasmuch as the 40 meter radials are also resonant on 15 meters, a separate set is not required for that band. This same system will provide enough capacitive coupling to ground for operation on 75/80 meters at antenna base heights below about 40 feet in some cases, but since ground conditions vary widely, it is advisable [illegible] use at least one resonant 80 meter radial in an above-ground installation.

Figure five shows a simpler system which uses a single resonant radial for 80/75, 40, 30, 20, 17, 12, and 10 meters. With this arrangement, the antenna resembles a bent dipole on any one band, and the radiation pattern contains both horizontal and vertical componants. The system in figure four, however, produces omnidirectional vertically polarized radiation. (Note: 30, 17, and 12 meter radials are not shown, but may be included in this type of system.)

Figure six illustrates the construction of a multiband radial which is resonant on 40, 20, 15, and 10 meters. Good quality 300 ohm TV ribbon lead should be used (velocity factor is critical), and the conductors should employ at least one strand of steel wire to support the weight of the radial. Four such radials will be the practical equivalent of the system shown in figure four for operation on 80 through 10 meters.

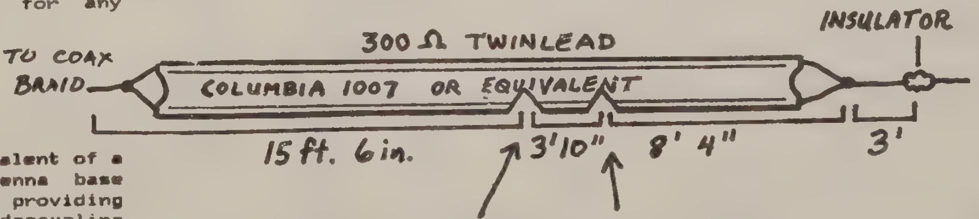
Regardless of the specific system used, radials should be well-insulated at their far ends and kept well clear of large masses of metal or other conductors that could cause detuning.

OTHER MOUNTING SCHEMES:

In cases where a resonant vertical antenna may be neither ground mounted nor used with an elevated ground plane, operation may still be possible if connection may be made to a large mass of metal that is directly or capacitively coupled to ground, e.g., central air conditioning systems or structural steel frames of apartment buildings. Some amateurs have reported good results with vertical antennas extended horizontally or semi-vertically from metal terraces which serve as the ground connection. Alternatively, a quarter-wave vertical may be window-mounted if a short ground lead to a cold water pipe or radiator can be used. If a long lead must be used, tuned radials will be required for resonance on one or more bands. GREAT CARE SHOULD BE EXERCISED IN SUCH INSTALLATIONS TO AVOID POWER LINES AND TO KEEP THE ANTENNA FROM FALLING ONTO PERSONS OR PROPERTY.

The metal shells of camper trailers, vans, and mobile homes may also be used as ground systems for vertical antennas. Whenever possible, the antenna should be mounted with its base close to the top of the roof, and the shortest possible ground lead should be used. Even so, tuned radials may be required for low SWR on one or more bands.

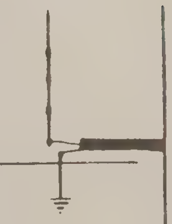
FIG. 6



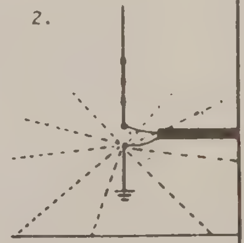
NOTCH OUT, CUTTING LOWER CONDUCTOR.

BELDEN 8230 MAY BE USED.

1.



2.



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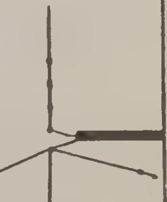

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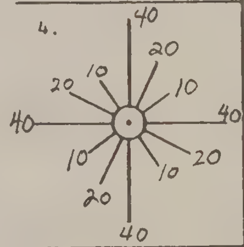

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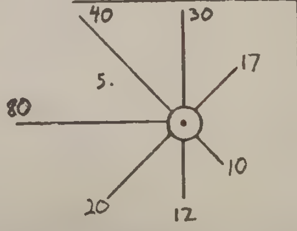

NOTES ON GROUND/RADIAL SYSTEMS FOR VERTICAL ANTENNAS

GROUND MOUNTING:

A vertical antenna in its simplest form is electrically equivalent to one-half of a dipole antenna stood on end. When the antenna is mounted close to the ground, the earth below takes the place of the "missing" half of the dipole. If ground conductivity is fair to good, a short metal stake or rod may provide a sufficiently good ground connection for resonant and low SWR operation on the bands for which the antenna is designed. This basic arrangement is shown in figure one. In almost every case, however, the efficiency of a vertical antenna will be greater if radial wires are used to improve ground conductivity as in figure two. Wire size is unimportant, and, in most ground-mounted installations, the radials may be any convenient length. They need not all be the same length, nor do they all need to be laid in a straight line. It is generally more convenient to slit the sod and to push the radials into the slits to a depth of several inches, but they may be left on the surface of the ground if they do not constitute a hazard. A large number of long radials will naturally be more effective in reducing ground losses than a small number of shorter ones, but one should remember that the greatest loss will occur in the earth near the base of the antenna where current flow is greatest. For this reason, it is generally better to use a larger number of radials of shorter length than a smaller number of longer ones for a given amount of wire.

In some cases wire mesh (e.g., "chicken wire") may be used as a substitute for radial wires and/or a ground connection, the mesh or screen acting as one plate of a capacitor to provide coupling to the earth beneath the antenna.

It should be noted that A GROUND ROD IS USEFUL ONLY AS A DC GROUND OR AS A TIE POINT FOR RADIALS. IT DOES NOTHING TO REDUCE RF GROUND LOSSES, REGARDLESS OF HOW FAR IT GOES INTO THE GROUND!

ABOVE GROUND MOUNTING:

It is possible to operate a vertical antenna at any height above ground provided that something be done to supply the equivalent of a ground connection. IT IS NOT ENOUGH TO RUN A LONG LEAD TO A GROUND STAKE OR COLD WATER PIPE, for current will flow in the lead, making it part of the overall antenna length and detuning the antenna on one or more bands. The usual approach to this problem is to install 3 or 4 resonant quarter-wave radials at the base of an elevated vertical and to connect them to the braid of the coaxial feedline as well as to the supporting mast or tower (if metal). Unlike the ground-mounted case, the length of above-ground radials is important, and the proper length(s) for any band may be found from the formula:

$$\text{Length (ft.)} = \frac{240}{\text{Frequency in Mhz}}$$

Four such radials, equally spaced, would be the equivalent of a highly conductive ground plane for any band at antenna base heights of one-half wavelength or more. In addition to providing a ground plane, radials of the proper length act as decoupling stubs to choke off current flow on any DC ground lead or grounded mast or tower, thus eliminating the detuning effect noted above. The basic ground plane system is shown in figure three. Radials may be run parallel to the earth or sloped downward any convenient amount without seriously affecting antenna feedpoint impedance or performance. Figure four shows a multi- band system using a separate set of radials for 40, 20, and 10 meters. Inasmuch as the 40 meter radials are also resonant on 15 meters, a separate set is not required for that band. This same system will provide enough capacitive coupling to ground for operation on 75/80 meters at antenna base heights below about 40 feet in some cases, but since ground conditions vary widely, it is advisable to use at least one resonant 80 meter radial in an above-ground installation.

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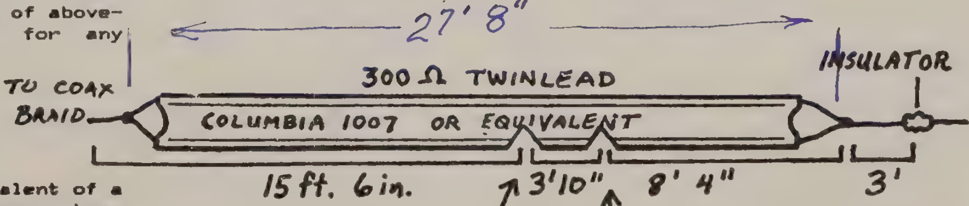

NOTCH OUT, CUTTING LOWER CONDUCTOR.

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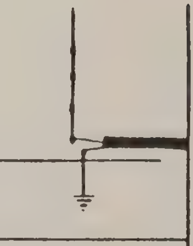
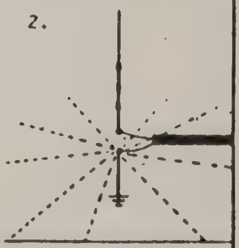
1.



2.



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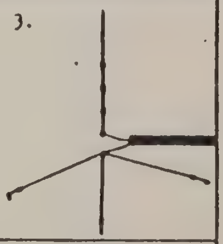

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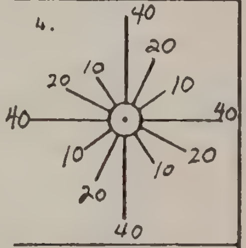

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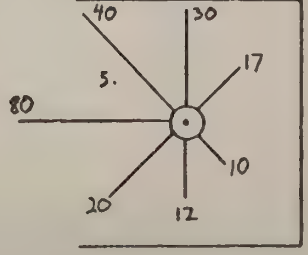

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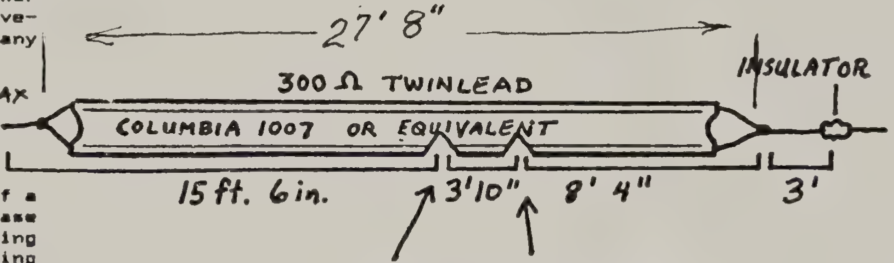

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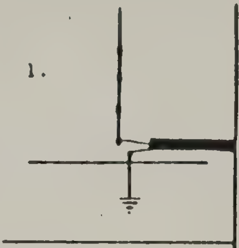
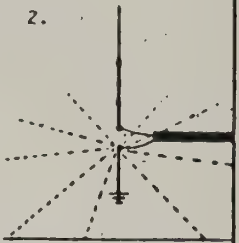
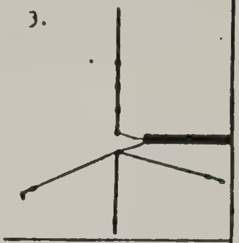


2.



3.



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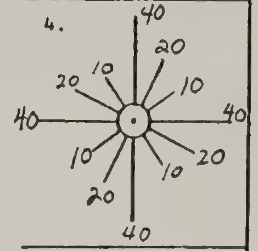

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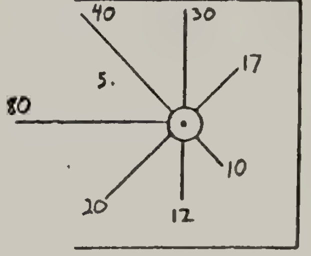
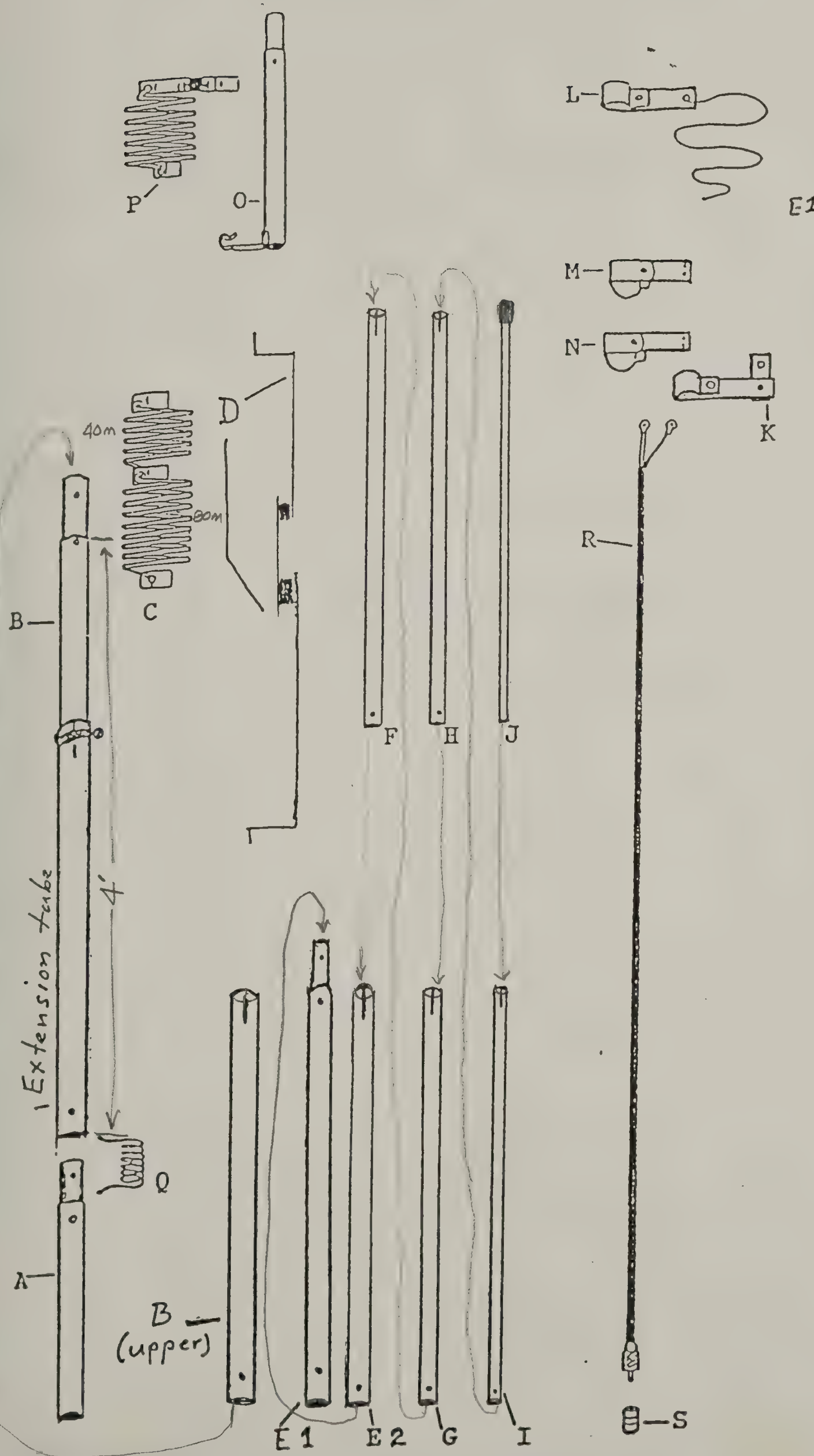




Not pictured: Packet of anti-oxide compound.
Weatherproof connector sealant.
(See page 11.)

PARTS LIST

A. Mounting post & Insulator
B. Antenna Base Section & Center Insulator Rod
C. 80 & 40 M Coil Assembly
D. 80 & 40 M Capacitor & Bracket Assembly
E1 { E2 Tubes 1" x 3 ft.
F. " 7/8" x 3 ft.
G. " 3/4" x 3 ft.
H. " 5/8" x 3 ft.
I. " 1/2" x 3 ft.
J. " 3/8" x 3 ft.
K. Clamp (7/8") with Insulator
L. Clamp (1/2") with Twisted Wire
M. (5/8") Clamp and Spacer
N. (3/4") Clamp and Spacer
O. 30 M Mounting Tube & "L"-Bracket
P. 30 M Coil & Capacitor Assembly
Q. Base Matching/Grounding Coil
R. 75-ohm Matching Line
S. PL-258 ("Barrel") Connector

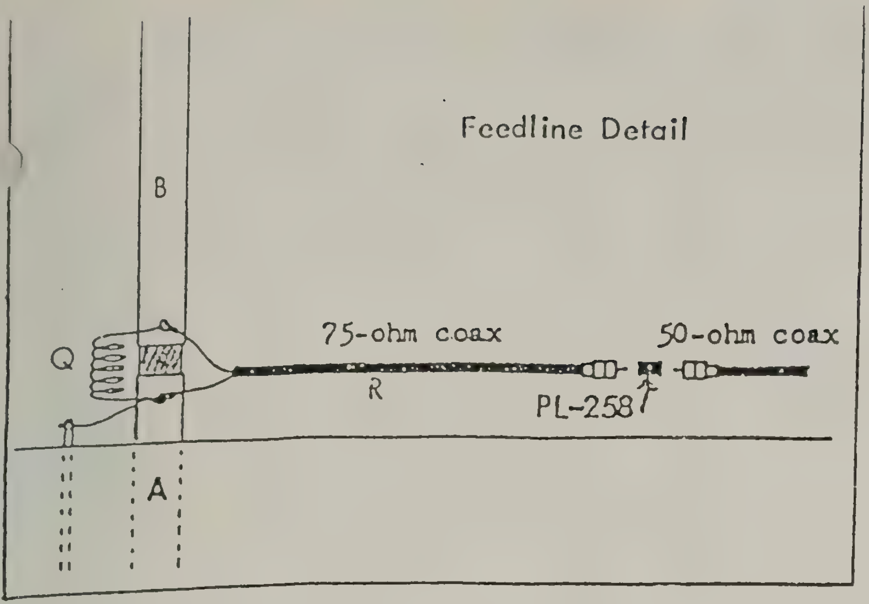
HARDWARE

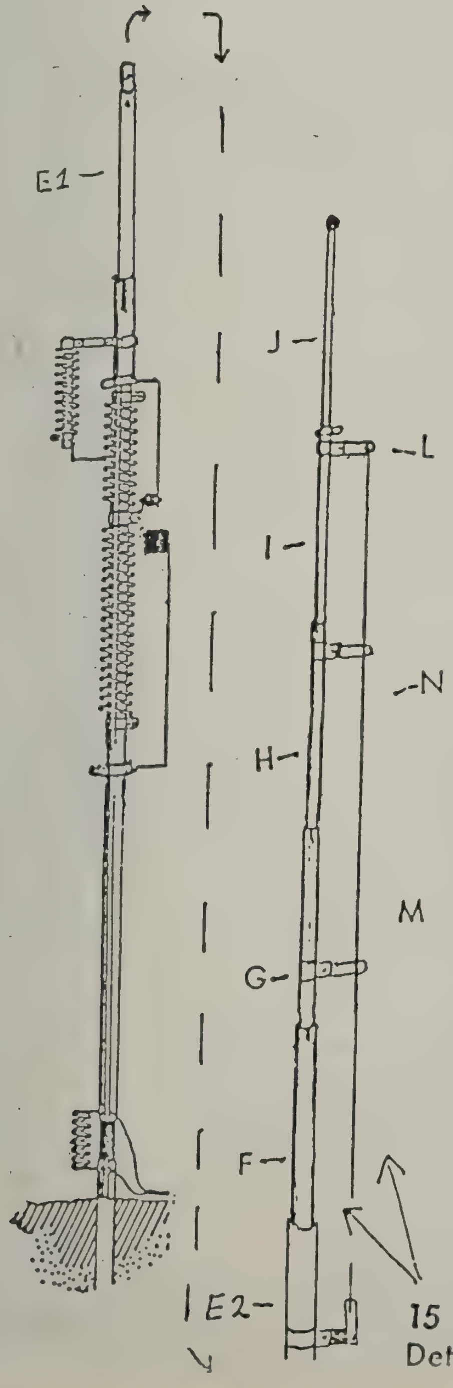
8 (Small)	Qty
3/4" bolt	4
1" bolt	4
1-1/4" bolt	2
1-1/2" bolt	1
2" bolt	1
Flat washers	4
Lock washers	14
Hex nuts	14

#10 (Large)	
1" bolt	1
Flat washers	1
Lock washers	7
Hex nuts	3
Wing nuts	4

Compression Clamps	
Large	2
Small (adjustable)	1

Feedline Detail



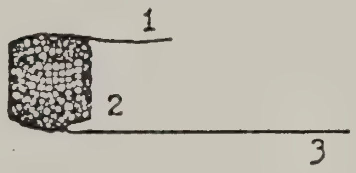


15 Meter Stub Detail (not to scale)

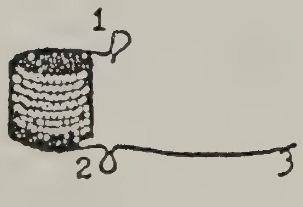
PICTORIAL PAGE

NOTE: *USE ANTI-OXIDE COMPOUND DURING ASSEMBLY!!! SEE PAGE 11.*

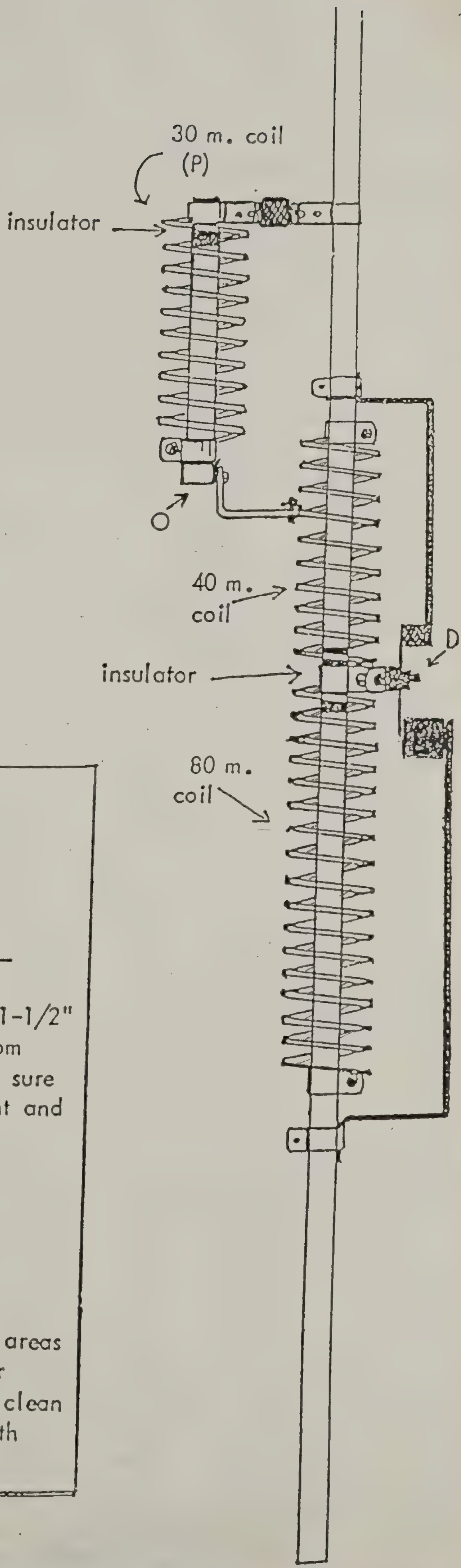
Preparing Coil (Q).



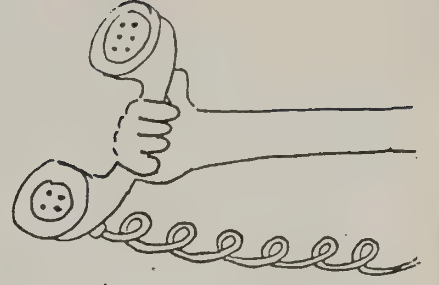
1. Use a knife to scrape 1-1/2" of enamel insulation from points 1, 2, and 3. Be sure that the copper is bright and clean.



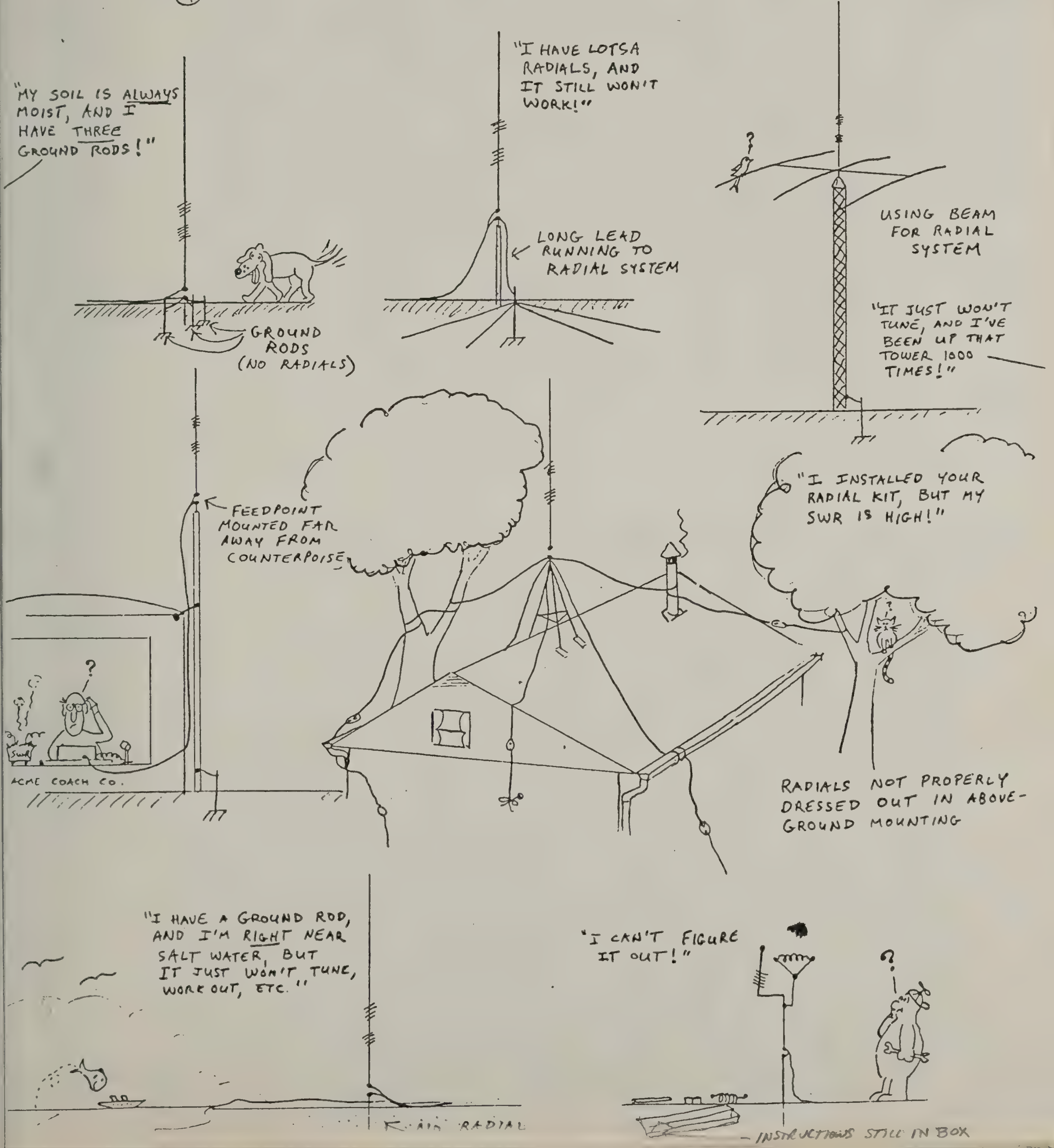
2. Bend two of the clean areas (1 and 2) into loops for connection later. The clean areas may be tinned with solder.



Before you call us



① FOLLOW THE INSTALLATION INSTRUCTIONS
② TUNE CAREFULLY & SYSTEMATICALLY
③ MAKE SWR CURVES
④ BE PREPARED TO DESCRIBE YOUR INSTALLATION


"MY SOIL IS ALWAYS MOIST, AND I HAVE THREE GROUND RODS!"
GROUND RODS (NO RADIALS)
"I HAVE LOTSA RADIALS, AND IT STILL WON'T WORK!"
LONG LEAD RUNNING TO RADIAL SYSTEM
?
USING BEAM FOR RADIAL SYSTEM
"IT JUST WON'T TUNE, AND I'VE BEEN UP THAT TOWER 1000 TIMES!"
FEEDPOINT MOUNTED FAR AWAY FROM COUNTERPOISE
?
SWR
ACME COACH CO.
"I INSTALLED YOUR RADIAL KIT, BUT MY SWR IS HIGH!"
?
RADIALS NOT PROPERLY DRESSED OUT IN ABOVE-GROUND MOUNTING
"I HAVE A GROUND ROD, AND I'M RIGHT NEAR SALT WATER, BUT IT JUST WON'T TUNE, WORK OUT, ETC."
← AIR RADIAL
"I CAN'T FIGURE IT OUT!"
?
— INSTRUCTIONS STILL IN BOX

BUTTERNUT ELECTRONICS COMPANY
405 East Market Street
Lockhart, TX 78644
(512) 398-7117

IF YOU HAVE PROBLEMS . . .

Check over your installation again. Be honest, now! Did you *really* read the instructions and follow them carefully? Are all your connections tight? OK? Then use the *SYMPTOM* list below to help locate the problem.

Symptom: Few or no signals heard; bands seem 'dead', SWR is very high.
Look for: Open or shorted feedline, open or shorted matching line (when used), broken connection at base of antenna (feedpoint).

Symptom: High SWR on 20m; other bands OK.
Look for: Missing matching line. Antenna not properly tuned. 20m radials not present or wrong length. Consult instructions for tuning and radial information; install matching line (RG-11 75 ohm coax, 11'4" if solid dielectric, 13'6" if foam type).

Symptom: High SWR on some bands, but signals heard on all bands (conditions permitting).
Look for: Missing or defective radial system. Install as per instructions and check connections to radials and ground system. Keep this connection 6 *inches* or less.

Symptom: High SWR on one band when antenna is roof-mounted. Radials are in place, but antenna will just not tune.
Look for: Radials of wrong length or running close to metal rain gutters or roof flashings. Tune radials and/or reroute them away from metal.

Symptom: Tuning is 'sharp' with narrow bandwidth on 80m (and 160m if TBR 160 is in place).
Look for: Normal condition. The total length of the antenna represents such a small % of a wavelength on these bands that sharp tuning is a normal condition.

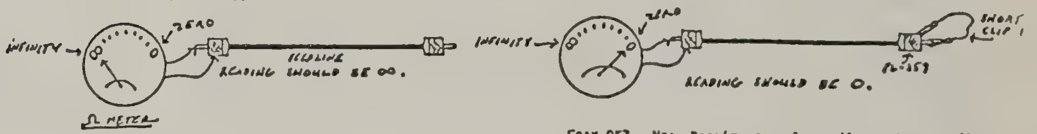
Symptom: Antenna was installed on the ground and tuned OK, but tuning changed over a period of weeks or months.
Look for: Antenna installed over poor ground system. Ground conditions have changed, causing shift in resonance. Install radial system as per instructions. Check connection to radial system. When you see this problem, you may assume that a ground rod without a radial system is not enough.

Symptom: Resonant point changes during wet weather.
Look for: Normal condition. Reduce high power operation in wet weather.

Symptom: Insulation arcs over between 80 and 40m coils, damaging the fiberglass.
Look for: Operation over the legal limit. Operation at high power levels during wet weather. Operation at high power levels in areas where salt or pollution deposits have built up on the insulators. The cure is to keep insulators clean through routine maintenance and to depend on operating skill instead of high power during adverse conditions.

Symptom: Intermittent operation. SWR jumps up and down suddenly, and reception is also intermittent.
Look for: Loose connections in the feedline or matching line (if used). Bad relay in rig Bad antenna switch or connecting cable. Broken or corroded connections at the feedpoint. Bad radial/ground connection. Radial or antenna contacting metal when wind blows. Loose hardware on the antenna. Check and secure all connections.

Open or shorted feedline or connectors--Check with ohm meter.

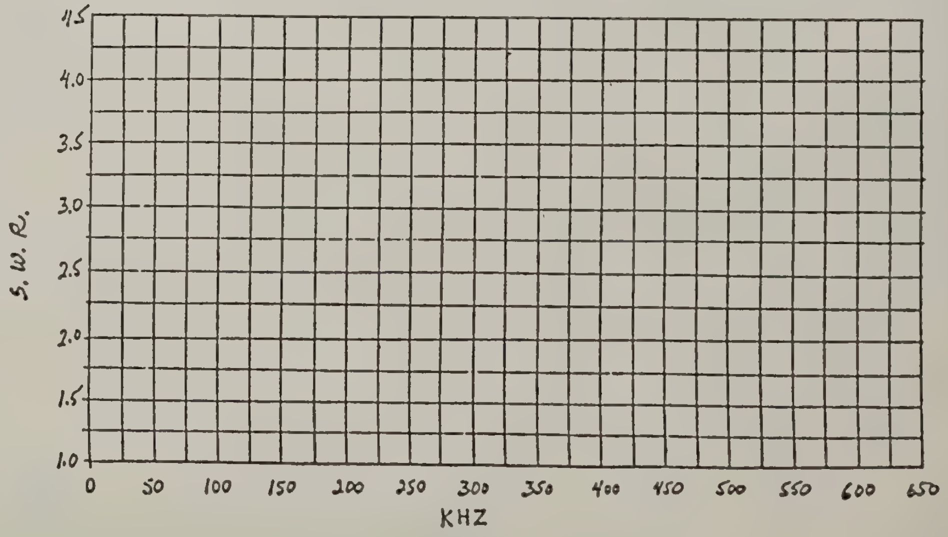


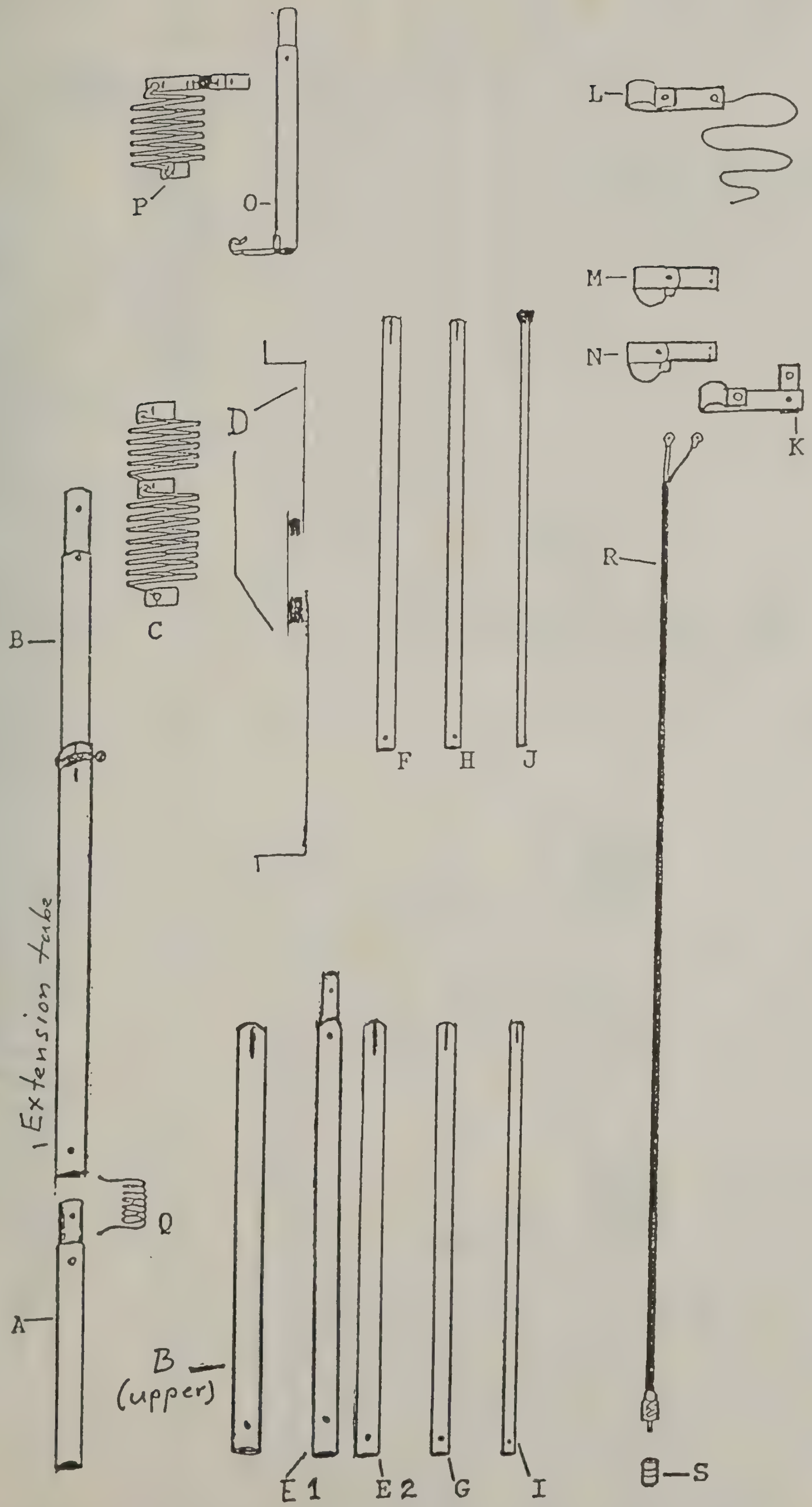
Coax OK? No: Repair or replace, then retest until OK.

Symptom: Antenna displays generally degraded performance after long period of time.
Look for: Lack of routine maintenance. Coax may be waterlogged or damaged. Build up of salt or pollution deposits on insulators and capacitors. Radial system corroded or rotted away. Owner must do routine maintenance at intervals, according to local conditions.

Symptom: SWR is OK on 75m, but goes up gradually when high power is applied. This is accompanied by heating of 200pF capacitor.
Look for: Bad ceramic capacitor. Replace. During adverse conditions (wet weather, icing, salt or pollution build-up) depend on operating skill instead of high power.

Symptom: Antenna doesn't tune on 80 or 160m, even though radials are in place and of proper length.
Look for: Antenna far out of tune; operator has not followed systematic tuning procedure. Start with suggested settings in instructions. Make an SWR chart to determine point of resonance. Adjust coils *carefully!* Remember, tuning is 'sharp' on these bands, so it is easy to pass the resonant point, then assume erroniously that the antenna isn't tuning.





Not pictured: Packet of anti-oxide compound.
Weatherproof connector sealant.
(See page 11.)

PARTS LIST

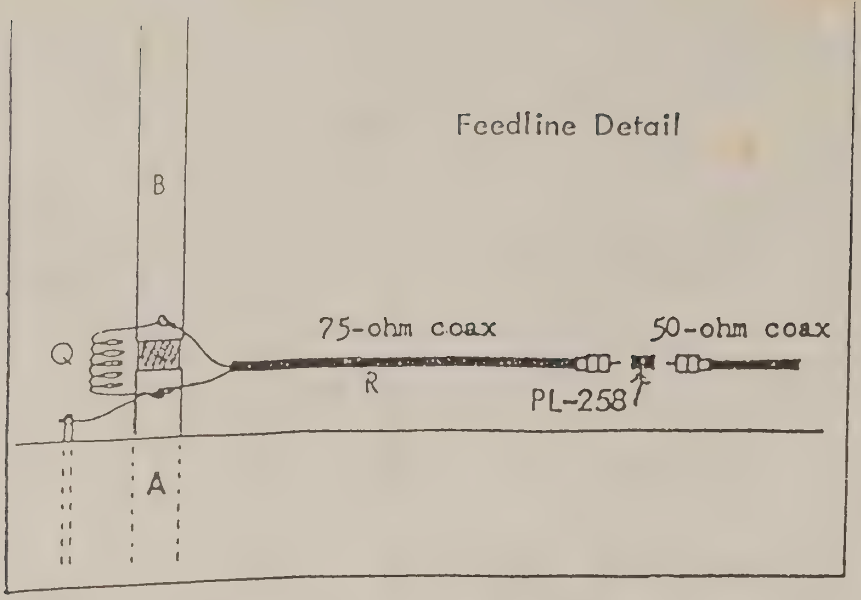
A. Mounting post & Insulator
B. Antenna Base Section & Center Insulator Rod
C. 80 & 40 M Coil Assembly
D. 80 & 40 M Capacitor & Bracket Assembly
E1 { E2 Tubes 1" x 3 ft.
F. " 7/8" x 3 ft.
G. " 3/4" x 3 ft.
H. " 5/8" x 3 ft.
I. " 1/2" x 3 ft.
J. " 3/8" x 3 ft.
K. Clamp (7/8") with Insulator
L. Clamp (1/2") with Twisted Wire
M. (5/8") Clamp and Spacer
N. (3/4") Clamp and Spacer
O. 30 M Mounting Tube & "L"-Bracket
P. 30 M Coil & Capacitor Assembly
Q. Base Matching/Grounding Coil
R. 75-ohm Matching Line
S. PL-258 ("Barrel") Connector

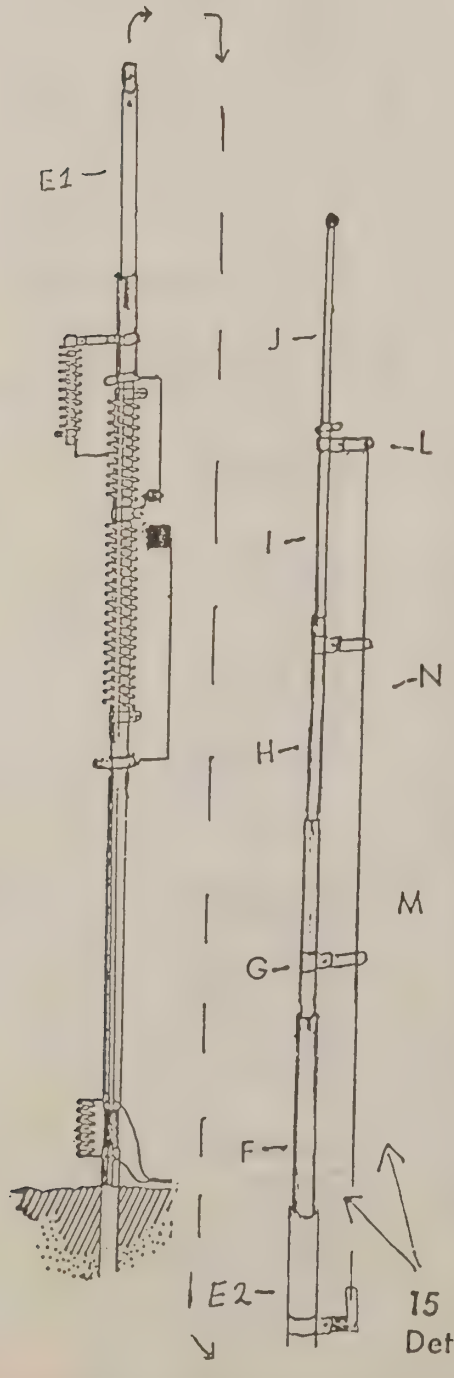
HARDWARE

8 (Small)	Qty
3/4" bolt	4
1" bolt	4
1-1/4" bolt	2
1-1/2" bolt	1
2" bolt	1
Flat washers	4
Lock washers	14
Hex nuts	14

#10 (Large)	
1" bolt	1
Flat washers	1
Lock washers	7
Hex nuts	3
Wing nuts	4

Compression Clamps	
Large	2
Small (adjustable)	1



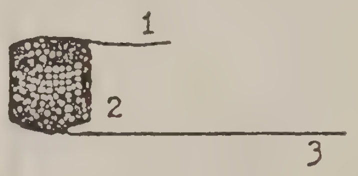


15 Meter Stub Detail (not to scale)

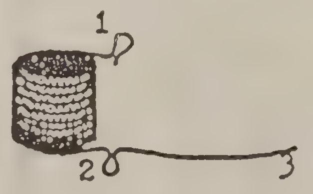
PICTORIAL PAGE

NOTE: *USE ANTI-OXIDE COMPOUND DURING ASSEMBLY!!! SEE PAGE 11.*

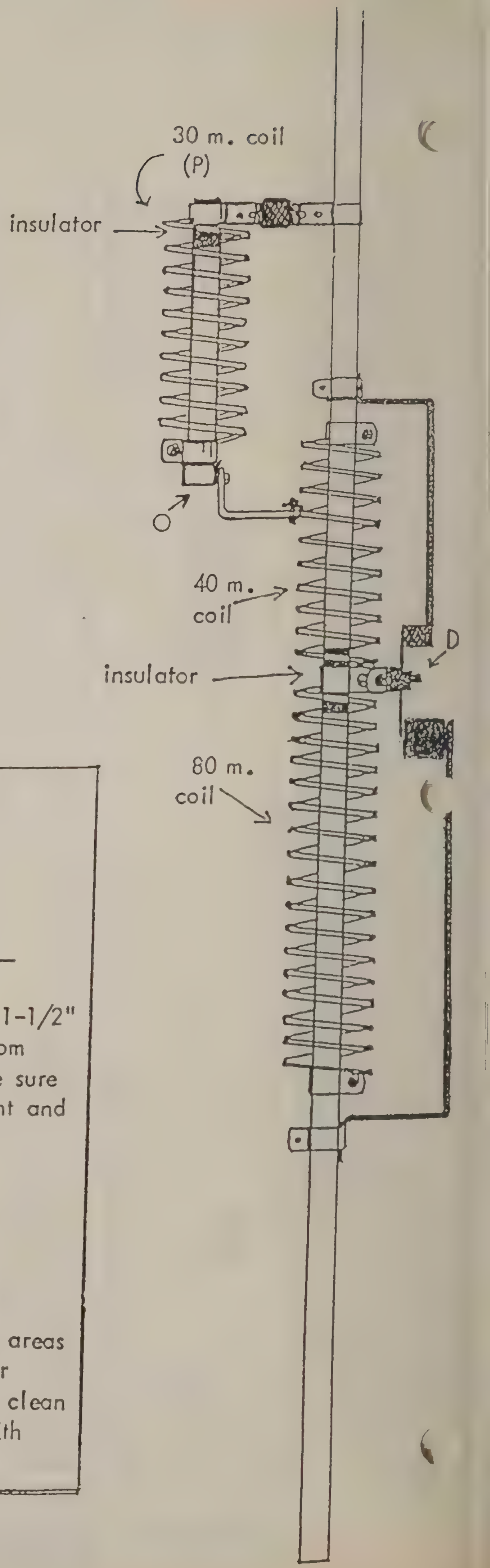
Preparing Coil (Q).



1. Use a knife to scrape 1-1/2" of enamel insulation from points 1, 2, and 3. Be sure that the copper is bright and clean.



2. Bend two of the clean areas (1 and 2) into loops for connection later. The clean areas may be tinned with solder.



BUTTERNUT ELECTRONICS COMPANY
405 East Market Street
Lockhart, TX 78644
(512) 398-7117

IF YOU HAVE PROBLEMS...

Check over your installation again. Be honest, now! Did you *really* read the instructions and follow them carefully? Are all your connections tight? OK? Then use the *SYMPTOM* list below to help locate the problem.

Symptom: Few or no signals heard; bands seem 'dead', SWR is very high.
Look for: Open or shorted feedline, open or shorted matching line (when used), broken connection at base of antenna (feedpoint).

Symptom: High SWR on 20m; other bands OK.
Look for: Missing matching line. Antenna not properly tuned. 20m radials not present or wrong length. Consult instructions for tuning and radial information; install matching line (RG-11 75 ohm coax, 11'4" if solid dielectric, 13'6" if foam type).

Symptom: High SWR on some bands, but signals heard on all bands (conditions permitting).
Look for: Missing or defective radial system. Install as per instructions and check connections to radials and ground system. Keep this connection 6 *inches* or less.

Symptom: High SWR on one band when antenna is roof-mounted. Radials are in place, but antenna will just not tune.
Look for: Radials of wrong length or running close to metal rain gutters or roof flashings. Tune radials and/or reroute them away from metal.

Symptom: Tuning is 'sharp' with narrow bandwidth on 80m (and 160m if TBR 160 is in place).
Look for: Normal condition. The total length of the antenna represents such a small % of a wavelength on these bands that sharp tuning is a normal condition.

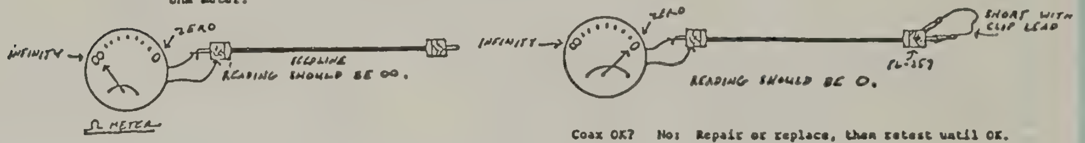
Symptom: Antenna was installed on the ground and tuned OK, but tuning changed over a period of weeks or months.
Look for: Antenna installed over poor ground system. Ground conditions have changed, causing shift in resonance. Install radial system as per instructions. Check connection to radial system. When you see this problem, you may assume that a ground rod without a radial system is not enough.

Symptom: Resonant point changes during wet weather.
Look for: Normal condition. Reduce high power operation in wet weather.

Symptom: Insulation arcs over between 80 and 40m coils, damaging the fiberglass.
Look for: Operation over the legal limit. Operation at high power levels during wet weather. Operation at high power levels in areas where salt or pollution deposits have built up on the insulators. The cure is to keep insulators clean through routine maintenance and to depend on operating skill instead of high power during adverse conditions.

Symptom: Intermittent operation. SWR jumps up and down suddenly, and reception is also intermittent.
Look for: Loose connections in the feedline or matching line (if used). Bad relay in rig Bad antenna switch or connecting cable. Broken or corroded connections at the feedpoint. Bad radial/ground connection. Radial or antenna contacting metal when wind blows. Loose hardware on the antenna. Check and secure all connections.

Open or shorted feedline or connectors--Check with ohm meter.

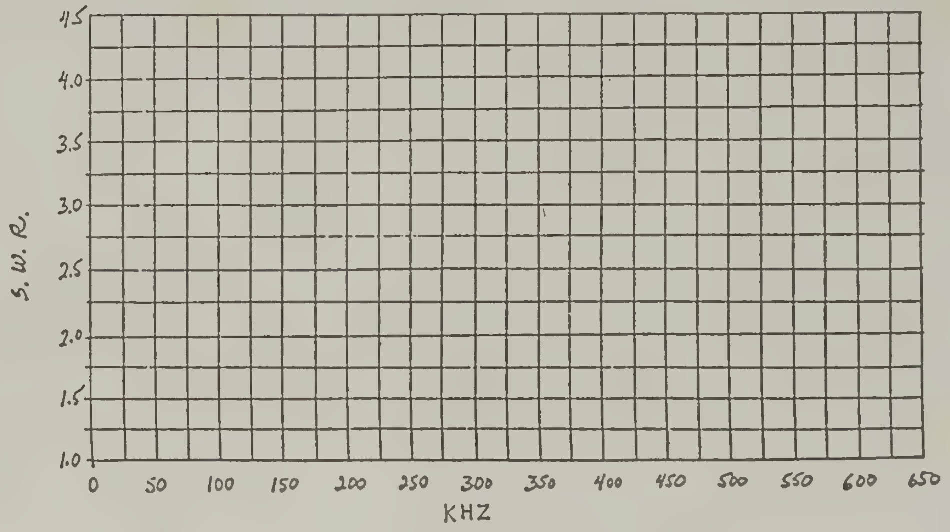


Coax OK? No: Repair or replace, then retest until OK.

Symptom: Antenna displays generally degraded performance after long period of time.
Look for: Lack of routine maintenance. Coax may be waterlogged or damaged. Build up of salt or pollution deposits on insulators and capacitors. Radial system corroded or rotted away. Owner must do routine maintenance at intervals, according to local conditions.

Symptom: SWR is OK on 75m, but goes up gradually when high power is applied. This is accompanied by heating of 200pF capacitor.
Look for: Bad ceramic capacitor. Replace. During adverse conditions (wet weather, icing, salt or pollution build-up) depend on operating skill instead of high power.

Symptom: Antenna doesn't tune on 80 or 160m, even though radials are in place and of proper length.
Look for: Antenna far out of tune; operator has not followed systematic tuning procedure. Start with suggested settings in instructions. Make an SWR chart to determine point of resonance. Adjust coils *carefully!* Remember, tuning is 'sharp' on these bands, so it is easy to pass the resonant point, then assume erroniously that the antenna isn't tuning.

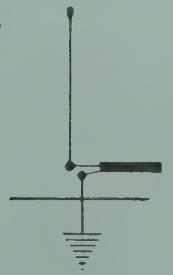


NOTES ON GROUND/RADIAL SYSTEMS

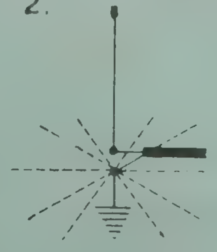
GROUND MOUNTING

A vertical antenna in its simplest form, is electrically equivalent to one-half of a dipole antenna stood on end. When the antenna is mounted close to the ground, the earth below takes the place of the "missing" half of the dipole. If ground conductivity is fair to good, a short metal stake or rod may provide a sufficiently good ground connection for resonant and low-SWR operation on the bands for which the antenna is designed. This basic arrangement is shown in figure 1.

1.



2.



In almost every case the efficiency of a vertical antenna will be greater if radial wires are used to improve ground conductivity as in figure 2. For ground mounted verticals using radials please note:

1. Radial wire size is unimportant and radials may be of any convenient length.
2. Radials need not all be the same length, nor do they have to be laid in a straight line. It is pointless to cut radials to resonant lengths because the ground will detune them.

It is generally more convenient to slit the sod and to push the radials into the slits to a depth of a few inches, but they may be left on the surface if they do not constitute a hazard. A large number of long radials will naturally be more effective in reducing ground losses than a small number of shorter ones, but one should remember that the greatest loss will occur in the earth near the base of the antenna where current flow is greatest. For this reason it is generally better to use a larger number of radials of shorter length than a smaller number of longer ones for a given amount of wire. For multiband operation over the HF range the best ground system will consist of as many radials of the greatest length that circumstances will permit.

In some cases wire mesh (i.e. chicken wire) may be used as a substitute for radial wires and/or a ground connection, the mesh or screen acting as one plate of a capacitor to provide coupling to the earth beneath the antenna. It should be noted that a ground rod is useful only as a d.c. ground or as a tie point for radials. it does little or nothing to reduce ground losses at r.f. regardless of how far it goes into the ground.

EFFICIENCY

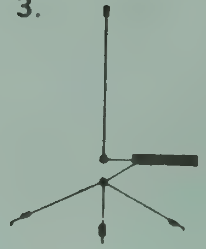
The importance of reducing losses in the ground system can be seen from an examination of a vertical antenna's feedpoint impedance which at resonance consists of three components: antenna radiation resistance; conductor loss resistance; and earth loss resistance. An unloaded quarter-wave vertical antenna has a radiation resistance of about 35 ohms with negligible ohmic or conductor loss, but ground loss resistance may be very great if no measures are taken to reduce it, and in some cases ground loss R may even exceed the antenna radiation resistance. These three components may be added to gether to arrive at the feedpoint **impedance** of a **resonant** (no reactance) antenna. For the sake of illustration, assume that the ground loss beneath a quarter-wavelength vertical antenna is 15 ohms, that conductor loss resistance is zero, and that the radiation resistance is the textbook figure of 35 ohms. The feedpoint impedance would then be 15+0+35 = 50 ohms, and the antenna would be perfectly matched to a 50 ohm coaxial line. Since the radiation resistance is an index of the amount of applied power that is consumed as useful radiation rather than simply lost as heat in the earth or in the conductor, the radiation resistance must be kept as high as possible in relation to the total feedpoint impedance for maximum efficiency. Efficiency, expressed as a percentage, may be found by dividing the radiation resistance by the total feedpoint impedance of a resonant antenna, so under the conditions assumed above our vertical antenna would show an efficiency of 35/50 = 70%. As a vertical antenna is made progressively shorter than one-quarter wavelength the radiation resistance drops rapidly and conductor losses from the required loading inductors increase. A one-eighth wave inductively loaded vertical would have a radiation resistance of something like 15 ohms and coil losses (or trap losses for multiband antennas) would be in the range of 5 ohms. Assuming the same value of ground loss resistance (15 ohms), the feedpoint impedance would become 15 + 5 + 15 = 35 ohms and the efficiency would be 15/35=43%. From the above calculations it is clear that the shorter a vertical antenna must be the less efficient it also must be for a given ground loss resistance. Or to state the matter another way, more elaborate ground or radial systems must be used with shorter verticals for reasonable efficiency. If the ground loss of resistance of 15 ohms from the preceding example could be reduced to zero ohms, it is easy to show that the efficiency of our one-eighth wavelength loaded vertical would increase to 75%. Unfortunately, more than 100 radials each one-half wavelength long would be required for zero ground loss, so lower efficiencies with shorter radials must usually be accepted for the sake of convenience. In spite of their limitations, short vertical antennas over less than ideal ground systems are often more effective DX performers than horizontal dipoles which must be placed well above the earth (especially on the lower bands) to produce any significant radiation at the lower elevation angles. Verticals, on the other hand, are primarily low-angle radiators on all bands.

ABOVE GROUND (ELEVATED) INSTALLATIONS (rooftop, tower, mast, etc.)

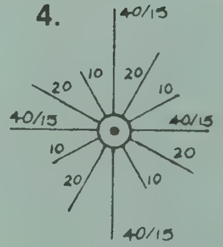
The problem of ground loss resistance may be avoided to some extent by mounting a vertical antenna some distance above the earth over an artificial ground plane consisting of resonant (usually quarter-wave) radial wires. Four resonant radials are considered to provide a very low-loss ground plane system for vertical antennas at base heights of one-half wavelength or more. This arrangement contrasts favorably with the more than 100 radials for zero ohms loss resistance at ground level, and since one-half wavelength is only about thirty-five feet at twenty meters, very worthwhile improvement in vertical antenna performance can be realized, at least on the higher bands, with moderate pole or tower heights. At base heights below one-half wavelength more than four radials will be required to provide a ground plane of significantly greater conductivity than the lossy earth immediately below the antenna; even so, a slightly elevated vertical with relatively few radials may be more effective than a ground-level vertical operating over a larger number of radials if only because the former is apt to be more in the clear. Resonant radial lengths for any band may be calculated from the formula:

$$\text{Length (ft)} = \frac{240}{\text{Frequency in MHz}}$$

3.



4.



5.

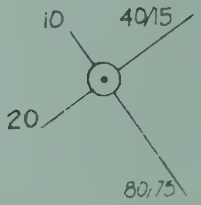


Figure 3 shows the basic ground plane system for elevated verticals. Radials may slope downward as much as 45 degrees without any significant effect on operation or performance. Radials for different bands should be separated as much as possible and the far end of each radial insulated from supporting wires. Figure 4 shows a ground plane system that uses four resonant radials for 40 meters, another set of four for 20 meters, and a third set for 10 meters. A separate set for 15 meters is not ordinarily required because the 40 meter radials operate as resonant ¾-wave radials on that band. At the lower heights the separate wires of this system may provide enough capacitance to ground to permit low SWR operation on 80/75 meters as well, but it is probable that at least one resonant radial will be required for low SWR on that band.

The 12-radial system of Fig. 4 is a very good one, but it requires at least 12 tie-off points. **Butternut Electronics** has developed a multiband radial made of 300-ohm ribbon that resonates simultaneously on 40, 20, 15 and 10 meters. Four such radials offer essentially the same ground plane performance as the system of Fig. 4 but require only 4 supports. These multiband radials plus additional wire for an 80 meter radial are available separately (our STR-II kit) or as part of the Butternut roof mounting kit (RMK-II.

There are times when physical restrictions will dictate the use of fewer than four radials, and at least one manufacturer recommends 2 radials per band, the radials for each band running 180 degrees away from each other. A simpler (and no doubt less effective) system is shown in Fig. 5. (Since only one resonant radial is used per band the antenna will radiate both vertically and horizontally polarized energy, and the pattern will not be completely omnidirectional. For true ground plane action and predominantly vertical polarization no fewer than three equally-spaced radials should be used.

Regardless of the number of radials used in either elevated or ground level systems, all radials should be attached to the ground connection at the antenna feedpoint by the shortest possible leads. An elaborate radial system at ground level, for example, cannot be used with a vertical antenna on a rooftop or on a tall tower, for the length of the ground lead would effectively become part of the antenna, thus detuning the system on most or all bands.

METAL TOWERS AND MASTS

If a metal mast or tower is used to support a vertical antenna all radials should be connected to the mast or tower at the ground connection of the antenna feedline. This is because one of the functions of a resonant radial is to detune a supporting metal structure for antenna currents that might otherwise flow on the structure and thus turn the vertical antenna system into a vertical long wire with unwanted high-angle radiation.

OTHER MOUNTING SCHEMES

In cases where a resonant vertical antenna may neither be ground mounted nor used with an elevated ground plane, operation may still be possible if connection can be made to a large mass of metal that is directly connected or capacitively coupled to the ground, e.g., central air conditioning systems or structural steel frames of apartment buildings. Some amateurs have reported good results with vertical antennas extended horizontally or semi-vertically from metal terraces which serve as the ground connection. Alternatively, a quarter-wave vertical may be window mounted if a short ground lead to a cold water pipe or radiator can be used. If a long lead must be used, tuned radials may be required for resonance on one or more bands. Great care should be exercised in such installations to avoid power lines and to keep the antenna from falling onto persons or property.

MOBILE HOME AND RV INSTALLATION

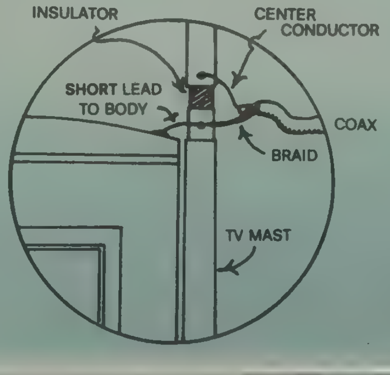
The principles of vertical antenna installations for use on mobile homes or RV's are the same as for other installations, and they all boil down to two main considerations. The first is that of erecting the vertical in the clearest possible spot, away from obstacles (including the MH or RV) that can interfere with radiation from the antenna. The second is that of installing the best possible ground system beneath the antenna in order to minimize losses from r.f. currents flowing in the earth below the antenna. Fortunately, the metal bodies of both MHs and RVs can be used as highly conducting ground planes for vertical antennas in exactly the same way that automobile bodies, etc., provide the ground system for shorter vertical antennas for mobile operation. The metal body of an automobile, MH or RV may be viewed as one plate of a capacitor. Since the surface area of even a small automobile is quite large and in close proximity to the earth, its body is tightly coupled to the earth below and may be considered simply as an extension of the earth itself—a kind of hill as far as radio frequencies are concerned, but one having higher conductivity than the earth itself. RVs and especially MHs, having much greater surface area, will therefore provide a more extensive and effective ground system than a large number of radial wires occupying the same space as the MH or RV.

As in mobile installations, a vertical antenna may be mounted almost anywhere on the body of the vehicle or MH and made to operate with reasonably low VSWR, but it is generally considered that the best possible location for a mobile antenna is in the middle of the roof of the vehicle, i.e., at the center of the vehicle's ground plane and at a point where the antenna will not be in the "shadow" of any part of the vehicle. It is not usually convenient, or even practical to install a relatively tall vertical on the roof of an RV or MH for any number of reasons, so the next best procedure would be to install a a vertical antenna with its base at the same level as the roof, preferably near the middle of one of the longer sides. The exact way in which this may be done is a matter of convenience, but a short mast extending from ground level to the roof of the MH and RV and placed alongside the building or RV would provide a stable and sturdy support with a minimum of mounting brackets and other modifications to the RV or MH. For portable operation such a mast could simply be lashed alongside the RV with the base in a shallow hole in the ground for additional support, and there would be no harm in extending the mast a few inches above the roof level to permit attachment of ropes which could be used to hold the mast firmly against the side of the vehicle and to prevent sidesway.

This system has been used successfully with various types of RVs, travel trailers, and even passenger automobiles during portable operation. For "L" shaped mobile homes a vertical antenna should be placed in the corner of the "L" so that the metal roof will provide groundplane coverage over 270 degrees.

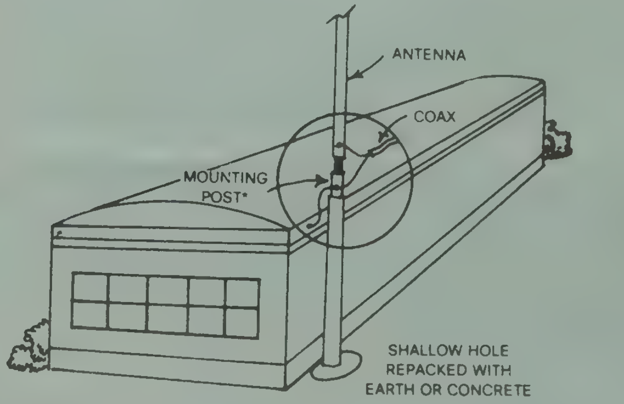
In all cases the base of the vertical antenna should not be more than a few inches away from the MH or RV so that the shortest possible lead may be run from the ground connection of the antenna to the metal body, as the length of this ground lead will effectively lengthen the antenna itself on all bands, and detuning can occur in some cases. A good electrical connection between the body of the RV or MH and the antenna is important, and in the case of mobile homes it would be a good idea to make sure that good electrical contact exists between the different parts of the metal body. Discontinuities can often lead to the production of harmonic radiation and TVI. The essential circuit connections are shown in the diagram below.

For permanent installations the bottom of the mast may be set deeper in the ground, and concrete may be used for greater strength and stability. The upper portion of the mast should be securely attached to the side of the building. Steel TV mast sections are readily available in lengths of ten feet and the mounting posts of **Butternut** HF verticals will slide into those which have an outside diameter of 1¼ inches and a wall thickness of .058 inches. Other vertical antennas may use different mounting techniques and requirements, so be sure to select a mast that will be suited to the particular situation. The main point to keep in mind is that the mast should not extend more than a few inches above the level of the roof so that the ground lead may be kept short.



LIGHTNING PROTECTION

Modern solid state amateur equipment is particularly vulnerable to damage from lightning or static induced transients that may appear on transmission lines, and conventional air-gap lightning protectors may provide no real protection at all for solid state gear. A line of very effective lightning and static protectors has been developed by ALPHA DELTA COMMUNICATIONS, P.O. Box 571, Centerville, Ohio 45459, for use with solid state equipment, and since these devices feature much faster transient discharge times than earlier designs, they should be investigated for possible use with all vertical and other antenna systems.



MOBILE HOME AND RV INSTALLATION

*Butternut Models

BUTTERNUT ELECTRONICS
405 E. Market St. • Lockhart, Texas 78644

12-8-88

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405 EAST MARKET STREET
LOCKHART, TEXAS 78644
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ASSEMBLY AND TUNING INSTRUCTIONS
Model A-18-24 (17 and 12 meter
conversion kit for Models HF5V-III,
HF6V and HF6V-X antennas
(copyright 1988)

The A-18-24 conversion kits consists of two capacitor. clamp and rod assemblies for the 17 and 12 meter bands, each assembly forming a parallel-resonant circuit "trap" circuit that limits current flow to the first quarter-wave portion of the radiator on each band without, however, requiring that the radiator be broken by insulators. Further, the high ratio of capacitance to inductance in each circuit greatly reduces the loading contributed by each circuit on the lower-frequency bands so that addition of the A-18-24 to existing 5- or 6-band units will not upset adjustments that have already made for the other bands.

PARTS LIST:

Quantity

1---ceramic capacitor mounted on double-clamp assembly (one large to fit 1" or 7/8" O.D. tubing--tighten as needed--and one small clamp for 3/16" rod

1---ceramic capacitor mounted on double-clamp assemoly for 3/4" O.D. tubing and 3/16" rod

1---double clamp for 1" tubing and 3/16" rod

1---double clamp for 7/8" tubing and 3/16" rod

1---double clamp for 3/4" tubing and 3/16" rod

1---3/16" rod 24"/61 cm. long

1---3/16" rod 36'/91 cm. long

Note: only two of the all-metal double clamps will be needed, and which two will depend on the particular model and series.

HARDWARE: attached to above parts

ASSEMBLY: (refer to drawing)

1. Measure up 123 inches/3.124 meters from the antenna feedpoint and place the appropriate all-metal double clamp around the tubing at that point. Measure up another 18.5 inches/47 cm. from that point and attach the double-clamp capacitor assembly for 1" or 7/8" tubing. Align the small end of the all-metal clamp and the small end of the capacitor clamp, pass the 24-inch x 3/16" rod through them, and tighten the hardware--not too tight, for later adjustment may be necessary. The excess rod material may extend below the lower clamp or above the upper one for the time being. This is the preliminary setting for the 24 mHz circuit.

2. Measure up 15.5 inches/39.4 cm. from the capacitor clamp for the 24 mHz circuit and place either the 7/8" or 3/4" all-metal clamp on the antenna at this point, the small end of the clamp pointing away from the 15 meter decoupling stub. Place the remaining capacitor clamp 35.25 inches/89.5 cm. above the upper edge of the all-metal clamp (also pointing away from the 15 M decoupling stub) and inset the 36" x 3/16" rod into the small end of each clamp. Tighten the hardware. This is the preliminary setting for the 18 mHz circuit.

FINAL ADJUSTMENT:

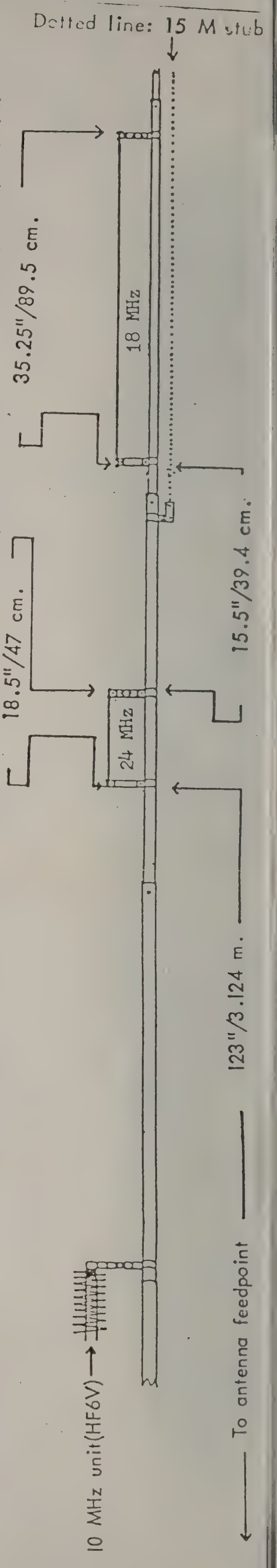
The above settings should provide reasonably low SWR over the 17 and 12 meter bands and should be entirely satisfactory for SWL work in those areas where amateur operation on these bands is not yet permitted. For transmitting purposes, however, SWR of 2:1 or less may be required, in which case slight departures from the above settings may have to be made. It will be found that tuning on 17 and 12 meters is quite a bit sharper than on the other bands and that slight changes is the spacing between the upper and lower clamps of each unit will cause the SWR curve to move considerably. Final adjustment for lowest SWR is covered in the following steps:

1. Construct an SWR curve for each band, plotting SWR vs. frequency. If lowest SWR occurs at the lower edge of either band loosen the hardware of the upper clamp for that band and slide the clamp downward along the antenna and the 3/16" rod in order to decrease inductance and thus raise the frequency of lowest SWR. If, on the other hand, lowest SWR occurs at the upper edge of a band slide the upper (capacitor) clamp upward along the antenna and the 3/16" rod to increase circuit inductance and thus lower the frequency of lowest SWR. In either case, these adjustment should be made in steps of no more than half an inch or so.

2. Please bear in mind that the antenna ground system, regardless of the form it might take, can have a great deal to do with antenna resonance and SWR. Lossy ground systems can cause unusually high feedpoint impedances and high SWR on coaxial lines. Elevated ground systems can be both lossy and reactive, depending on the length of the wires that make them up, their proximity to the earth or to other conductors, and so on. If the ground system is reactive it may be found that the antenna system as a whole is so far from resonance that the SWR may remain unacceptably high across an entire band regardless of the adjustments made to the vertical radiator and its tuning circuits. In general, however, a ground-level radial system or a slightly elevated capacitive counterpoise system that permits low-SWR operation on the other HF bands will also suffice for 12 and 17 meters, although an elevated system that uses resonant radials for the pre-WARC bands only may require additional resonant radials for the new bands. For antenna base heights of a quater-wavelength or more above ground the length of a resonant quarter-wave radial may be calculated from the formula:

Length (in feet) = 240/Frequency in mHz

To obtain the correct length in meters simply multiply the result by .3048. A minimum of two resonant radials per band should be used with elevated verticals, and all radials should be separated from adjacent radials by as great a distance as practicable.



butternut

Instructions

Model HF9V

WARNING: DO NOT INSTALL THE ANTENNA WHERE ANY PART OF IT CAN COME INTO CONTACT WITH POWER LINES IN THE EVENT OF STRUCTURAL FAILURE, DURING INSTALLATION OR IN THE COURSE OF NORMAL FLEXING AFTER INSTALLATION FOR SUCH CONTACT CAN RESULT IN DAMAGE TO PROPERTY, BODILY INJURY OR EVEN DEATH!

WARNING: IN NO CASE SHOULD THE ANTENNA BE INSTALLED WHERE STRUCTURAL FAILURE OF ANY PART OF THE ANTENNA OR ITS SUPPORTING SYSTEM CAN ENDANGER PERSONS OR PROPERTY.

CAUTION! A GROUNDED ANTENNA WILL BE AT D.C. GROUND POTENTIAL! TO AVOID THE DANGER OF SHOCK CONNECT ALL STATION EQUIPMENT TO A GOOD EARTH GROUND. IT IS ALSO RECOMMENDED THAT ALL STATION EQUIPMENT BE DISCONNECTED FROM THE POWER MAINS BEFORE CONNECTING THE FEEDLINE TO THE ANTENNA. PLEASE CONSULT THE A.R.R.L HANDBOOK OR OTHER REFERENCE MANUALS FOR ADDITIONAL SAFETY PROCEDURES WHEN WORKING WITH ELECTRICAL EQUIPMENT.

NOTE: PLEASE READ ALL INSTRUCTIONS THOROUGHLY BEFORE PROCEEDING TO ASSEMBLY.

NOTE: HIGH PERFORMANCE BUTTERNUT VERTICAL ANTENNAS REQUIRE A RADIAL SYSTEM FOR ALL INSTALLATIONS.
Butternut offers three systems for installing vertical antennas:

- Model GRK Ground Radial Kit for ground mounting—160 thru 6 meter operation
- Model RMK-II Roof Mounting Kit for roof mounting—80 thru 6 meter operation
- Model CPK Capacitive Counterpoise Kit for compact installations below 25 ft (7.6 m) above the earth—80 thru 6 meter operation

Please refer to TECH NOTES—GROUND/RADIAL SYSTEMS, at the end of this instruction, for other mounting schemes and assistance in designing your own radial system.

47-838
3195

REQUIRED TOOLS

Flat blade screwdriver and pliers. A 1/4", 11/32" and 3/8" nut driver will be helpful.

ASSEMBLY

Refer to the appropriate diagrams and proceed as follows:

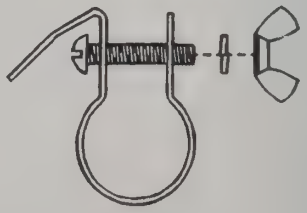
1. Check to be sure that all parts are present.
2. Install tube w/insulator (A) per instructions packaged with mounting system or Tech Notes Ground/Radial Systems.

NOTE: A small packet of anti-seize/anti-oxide compound (Butter-It's-Not™) will be found inside tube w/insulator (A). This compound should be applied lightly to each tubing joint and to the inside of all clamps that must make good electrical contact with the tubing sections.

3. Locate tube (B) and tube (B1). Slide the insulator end of tube (B1) into the end of tube (B) with hole located 1/4 in (6.4 mm) from the end of the tube. Pass a # 8 x 1 1/2" screw through both parts and secure with a lock washer and hex nut.
4. From the center of the insulator, measure downward to a point that is 13 in (33 cm) along tube (B) and make a pencil mark.
5. From the center of the insulator, measure upward to a point that is 9 3/8" (23.8 cm) along tube (B1) and make a pencil mark.
6. Locate coil assembly 80/40 meter (C) and slide the clamp at the outer end of the larger 80 meter coil over tube (B1), lowering the entire assembly until the middle clamp can be positioned around the insulator between tube (B) and tube (B1).

NOTE: The middle clamp may have to be pulled open slightly to pass the bolt that goes through tube (B1) and the insulator.

7. Position the center coil clamp of coil assembly 80/40 meter (C) in the center of the insulator between tube (B) and tube (B1). Pass a #10 x 1" screw through the clamp as shown. Secure with a flat washer, lock washer and wing nut.



ASSEMBLY

NOTE: The outer tab of this clamp may be bent back slightly to provide clearance for the bolt, bending it back into place after assembly.

8. Stretch the 40 meter (smaller) coil on the coil assembly 80/40 meter (C) until the top of the upper clamp is even with the upper mark. Secure with a #10 flat washer, lock washer and wing nut.

9. Stretch the 80 meter (larger) coil on the coil assembly 80/40 meter (C) until the bottom of the lower clamp is even with the lower mark. Secure with a #10 flat washer, lock washer and wing nut.

10. Locate the capacitor assembly 80/40 meter (D) and install capacitor bracket 80 meter (D1) on the larger 200 pF capacitor using the installed screw.

NOTE: DO NOT USE EXCESSIVE FORCE OR OVER TIGHTEN THE SCREWS ON EITHER CAPACITOR AS YOU WILL DAMAGE THEM. DO NOT DROP THIS ASSEMBLY AS YOU MAY FRACTURE THE CAPACITOR'S CERAMIC SHELL.

11. Locate capacitor bracket 40 meter (D2) and install on the smaller 67 pF capacitor as above.

12. Install the above assembly onto the #10 screw protruding from the tab of the center clamp on the coil assembly 80/40 meter (C). Align capacitor bracket 80 meter (D1) alongside the larger 80 meter coil of coil assembly 80/40 meter (C). Secure with a #10 flat washer, lock washer and hex nut.

13. Attach the tab end of capacitor bracket 80 meter (D1) to tube (B) with capacitor bracket clamp and secure with # 8 x 1" screw, lock washer and a hex nut.

14. Attach the tab end of capacitor bracket 40 meter (D2) to tube (B1) as above.

15. Insert the un-slotted end of tube (E) into tube (B1) and secure with a # 8 x 1 1/2" screw, lock washer and hex nut.

16. Locate coil support tube 30 meter (O) and measure to a point 9 7/8 in (25.1 cm) down from the plastic insulator. Mark this point with a pencil.

17. Locate coil support tube 30 meter L bracket (O1) and place the tabbed end inside of the coil support tube 30 meter (O) securing it with a # 8 x 3/4" screw, lock washer and hex nut.

18. Place a #10 washer, lock washer and wing nut on the lower single clamp of

coil/capacitor assembly 30 meter (P).

19. Place a #10 washer, lock washer and hex nut on both upper clamps of coil/capacitor assembly 30 meter (P).

20. Pass the lower single clamp of coil/capacitor assembly 30 meter (P) over the insulator end of coil support tube 30 meter (O) and slide the coil downward along the tube until the upper edge of the upper clamp is flush with the end of the insulator. Align the upper clamp with the coil support tube 30 meter L bracket (O1) and tighten the hex nut.

21. Stretch the coil until the bottom of the bottom clamp on the coil/capacitor assembly 30 meter (P) is even with the mark on coil support tube 30 meter (O) and tighten the wing nut.

22. Slide the remaining clamp from the above assembly over tube (E) and position it so the coil support tube L bracket (O1) is even with fourth turn, counting from the top of the 40 meter coil on the coil assembly 80/40 meter (C) and tighten the hex nut.

23. Hook the coil support tube 30 meter L bracket (O1) around the fourth turn of the 40 meter coil on coil assembly 80/40 meter (C). Secure with a # 8 x 3/4" screw, lock washer and hex nut.

24. Attach strip 17 meter (X) to the bolt that fastens the coil to the plastic insulator between the coil and the upper clamp of the Coil Assembly 17 Meter A-17-12 (W). Use the attached flat washer, lock washer and hex nut.

25. Attach the strip 12 meter (Z) to the coil assembly 12 meter A-17-12 (Y) in the same way.

26. Loosen the #10 hex nut on the bottom clamp and the wing nut on the upper clamp of coil assembly 17 meter A-17-12 (W) and slide the assembly over the upper end of tube (E) with the insulator end up.

27. Slide the unit down until the lower clamp of the coil assembly 17 meter A-17-12 (W) rests on the upper clamp of the coil/capacitor assembly 30 meter (O).

28. Tighten the hex nut and stretch the coil so that the distance between the upper edge of the lower clamp and the lower edge of the upper clamp is 10 1/2 in (26.7 cm).

29. Install the coil assembly 12 meter A-17-12 (Y) in the same way, so the lower edge of the lower clamp is about 2 in (5.1 cm) above the upper clamp of the coil assembly 17 meter A-17-12 (W). This distance is not critical.

ASSEMBLY

30. Tighten the hex nut and stretch the coil so that the distance between the upper edge of the lower clamp and the lower edge of the upper clamp is 8 3/4 in (22.2 cm).

31. Position wire clamp 0.875" 15 M w/insulator (K) around tube (F) and use a # 8 x 1" screw, lock washer and hex nut finger tight.

32. Slide wire clamp 0.875" 6 M w/insulator (V) around tube (F).

33. Insert the un-slotted end of tube (G) into the slotted end of tube (F) and secure with a # 8 x 1 1/4" screw, lock washer and hex nut.

34. Position wire clamp 0.750" 6 M w/insulator (U) around tube (G).

35. Locate wire clamp 0.750" 15 M w/insulator (N) and position it around tube (G).

36. Insert the un-slotted end of tube (H) into the slotted end of tube (G) and secure with a # 8 x 1" screw, lock washer and hex nut.

37. Position wire clamp 0.625" 6 M w/wire (T) around tube (H) so the top edge is 33 1/4 in (84.5 cm) from the upper end of the tube.

38. Pass the free end of the stranded wire from wire clamp 0.625" 6 M w/wire (T) through the small hole in wire clamp 0.750" 6 M w/insulator (U).

39. Line up and position the bottom edge of wire clamp 0.875" 6 M w/insulator (V) 58" (1.5 m) from the upper edge of wire clamp 0.625" 6 M w/wire (T) and tighten.

40. Pass the free end of the stranded wire from wire clamp 0.625" 6 M w/wire (T) through the small hole in wire clamp 0.875" 6 M w/insulator (V). Loop the free end of the wire around itself. Do not cut off the excess.

41. Center and align wire clamp 0.750" w/insulator (U) and tighten.

42. Locate wire clamp 0.625" 15 M w/insulator (M) and position it around tube (H).

43. Insert the un-slotted end of tube (I) into the slotted end of tube (H) and secure with a # 8 x 1" screw, lock washer and hex nut.

44. Position wire clamp 0.500" 15 M w/wire around tube (I) so the top edge is 13.5 in (34.3 cm) from the upper end of the tube and on the opposite side from the 6 meter assembly.

ASSEMBLY

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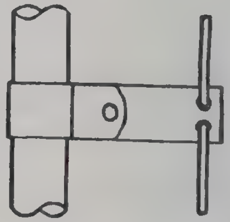
45. Measure from the rivet of wire clamp 0.500" 15 M w/wire (L) to a point 11 ft 3 in (3.4 m) along the stranded wire and mark this point.



46. Pass the free end of the stranded wire from wire clamp 0.500" 15 M w/wire (L) through the small holes in wire clamp 0.625" 15 M w/insulator (M) and wire clamp 0.750" 15 M w/insulator (N) as shown.

47. Loop the end of the wire through the hole in wire clamp 0.875" 15 M w/insulator (K) sliding it on tube (F) until the mark on the wire appears. Wind the wire back on itself. Do not cut off the excess wire.

48. Line up wire clamp 0.875" 15 M w/insulator (K), wire clamp 0.750" 15 M w/insulator (N) and wire clamp 0.625" 15 M w/insulator (M) with wire clamp 0.500" 15 M w/wire (L) and tighten all clamps making sure the wire is moderately taut but not enough to cause the upper tubing section to bow.

49. Place the protective cap on one end of tube (J).

50. Slide the uncapped end of tube (J) into the slotted end of tube (I) until only 25 in (63.5 cm) extends and secure with compression clamp small adjustable.

[illegible] only

NOTE: In the following steps the antenna will be assembled and raised to its full vertical height. If the antenna is to be installed in an elevated position where it is unsafe or inconvenient to make in-place adjustments, the antenna may have to be installed in one piece. It will probably be necessary to raise and lower it and its supporting structure a number of times to arrive at the *ideal* adjustment on all bands. If so, every precaution should be observed in order to avoid possible contact with power lines and to prevent structural failure that can cause injury to persons or property.

51. Place the lower end of tube (B) through tube (E) over the insulator on tube (A) w/insulator. Line up the holes and secure it with a # 8 x 2" screw, lock washer and hex nut.

WARNING: AVOID POWER LINES!

52. Raise the assemble of tube (F) through tube (J) and slide the lower end into tube (E) fastening it securely with a # 8 x 1 1/4" screw, lock washer and hex nut.

ASSEMBLY

53. Install coax 75 ohm matching (R) as shown placing the lug from the center conductor over the screw on tube (B) and the braid over the screw on tube w/insulator (A).

54. Place # 8 washers over each screw and install coil (Q) base matching. Secure with washers, lock washers and hex nuts.

NOTE: Attach radials and ground to tube w/insulator (A) using the remaining # 8 hardware.

WARNING: MAKE SURE THAT THE STATION EQUIPMENT IS CONNECTED TO A GOOD EARTH GROUND! DO NOT HANDLE CABLE CONNECTED TO STATION EQUIPMENT WITHOUT FIRST DISCONNECTING THE EQUIPMENT FROM THE POWER MAINS. YOU COULD BE ELECTROCUTED!

55. Connect coax 75 ohm matching (R) to any length of 50-53 ohm coaxial cable. Connector PL258 (S) is provided. Seal the connection with the small roll of Konnector-Kote.

CHECKOUT AND ADJUSTMENT

The dimensions and coil settings given above should produce reasonably low VSWR readings over the entire 10, 15, 20 and 30 meter bands and over at least 250 kHz of the 40 Meter band. Bandwidth on 80/75 meters should be at least 30 kHz for VSWR of 2:1 or less at the low end of the band and may be as much as 100 kHz at the high end of the band, depending on the efficiency of the ground system used, greater bandwidth being associated with lossy ground systems. It should be remembered that on those bands where the physical height of a vertical antenna is less than a quarter wavelength, the earth (or the resonant radial system in above-ground installations) will have a good deal to do with VSWR and antenna tuning, bandwidth and overall performance.

Low VSWR by itself does not mean that a vertical antenna is operating efficiently, and if low VSWR is obtained with no more than the usual *quick and dirty* ground connection, it most likely means the opposite. In general, poor operation or improper tuning of vertical antennas can usually be attributed to inadequate (or even reactive) ground systems or to other vertical conductors in the vicinity of the antenna. For these reasons it is suggested that the antenna be placed as much in the clear as possible and used with the best ground system that conditions permit. For a more complete discussion of the interrelationships between vertical antenna efficiency, bandwidth, VSWR, etc., a standard text such as the A.R.R.L. Antenna Book is recommended. See also the material included at the end of these instructions.

CHECKOUT AND ADJUSTMENT

For adjustment purposes a simple VSWR indicator may be used. More accurate measurements may be made at the antenna (i.e., at the junction of the coax 75 ohm matching (R) and the main transmission line) than at the input end of the line, but the tuning conditions that exist at the transmitter will usually be of greater interest in that one's principal concern will be to couple power from the transmitter into the transmission line.

1. Determine the frequency at which VSWR is lowest on 80/75 meters. The coil setting given earlier should produce resonance and lowest VSWR at approximately 3700 kHz. To raise the frequency of resonance of the lowest VSWR, simply loosen the wing nut on the lower coil clamp of the coil assembly 80/40 meter (C) coil on tube (B) and stretch the coil a bit more. To lower the frequency, compress the coil. A 1 in (2.5 cm) change in the setting of this coil will produce a frequency shift of approximately 125 kHz.

NOTE: Remember that the antenna tunes very sharply in this range and that high values of VSWR may be encountered only a few kHz either side of the lowest VSWR readings, so it would be well to take VSWR readings every 25 kHz or so to avoid *running past* the frequency of resonance and lowest VSWR.

NOTE: To minimize interference to other stations and to avoid erroneous reading use only enough power to produce full-scale deflection of the meter in the *forward* or *r.f. out* position.

2. Once the proper coil setting has been found for the desired band segment, coil (Q) base matching at the base of the antenna may be adjusted for even lower VSWR. If earth losses are moderate to high a good match may be possible if coil (Q) base matching is left fully compressed; if earth losses are low (as with an extensive radial system) coil (Q) base matching may have to be stretched to twice its compressed length or more for a good match. In any case, a single setting for coil (Q) base matching should suffice for operation over most of 80/75 meters provided the 80 meter coil is readjusted for each different band segment.

3. Determine the frequency of minimum VSWR on 40 meters. The coil setting given earlier should produce resonance and lowest VSWR at approximately 7150 kHz. The 40 meter VSWR and resonance curve may be shifted in the same manner as on 80/75 meters by changing the setting of the upper coil clamp of coil assembly 80/40 meter. On this band the setting is much less critical, and a 1 in (2.5 cm) change in the clamp setting will shift the VSWR curve approximately 80 kHz. Be sure to loosen the clamp around tube (E) that supports the 30 meter assembly and to reposition it as needed to avoid distorting the 40 meter coil.

CHECKOUT AND ADJUSTMENT

4. Check VSWR on 20 meters. Tuning is quite broad on this band because the antenna is physically much taller than a quarter wavelength. To raise the frequency of the lowest VSWR, reposition the 30 meter assembly so that the coil support tube 30 meter L bracket (O1) can be replaced on the next lower turn of the 40 meter coil. Alternatively, to lower the frequency of lowest SWR, reconnect the coil support tube 30 meter L bracket (O1) to the next higher turn of the 40 meter coil. In some cases moving the tap point a full turn up or down may cause more of a frequency shift than is desired, in which case the entire 30 meter assembly may be rotated around tube (E) to permit adjustments of less than one full turn.

5. Check VSWR on 15 meters. The VSWR curve may be shifted upward or downward by changing the length of the stranded wire between wire clamp 0.500" 15 M w/wire (L) and wire clamp 0.875" 15 M w/insulator (K). To raise the frequency, simply shorten the wire by wrapping a longer *tail* back on itself and sliding the lower clamp upward to maintain tension. To lower frequency, feed more of the *tail* back through the hole in the insulator to increase the length of the wire between wire clamp 0.500" 15 M w/wire (L) and wire clamp 0.875" 15 M w/insulator (K). A change of 2 in (5.1 cm.) will shift the VSWR curve approximately 300 kHz.

6. Check VSWR on 10 meters. To raise the resonant frequency loosen the small hose clamp over the slotted end of tube (I) and slide tube (J) farther into tube (I); to lower the frequency, slide tube (J) farther out of tube (I) and retighten the hose clamp. A length change of 3 in (7.6 cm) should move the VSWR curve approximately 200 kHz.

7. Check VSWR on 30 meters. To raise frequency, loosen the wing nut on the bottom coil clamp of coil/capacitor assembly 30 meter (P), stretch the coil and retighten the wing nut. To lower frequency, compress the coil. A change of only 1/4 in (6.4 mm) will shift the VSWR curve approximately 100 kHz. Large changes in the setting of coil/capacitor assembly 30 meter (P) may affect 20 and 40 meter tuning, in which case it may be necessary to repeat steps 3 and 4. In general, the point at which the 30 meter coil taps on to the 40 meter coil will be the major factor in 20 meter tuning.

8. Check VSWR on 17 meters. To move the SWR curve to a higher frequency loosen the wing nut on the upper coil clamp and STRETCH the coil about 1/4 in (6.4 mm) at a time. To move the SWR curve to a lower frequency range COMPRESS the coil a like amount.

9. Check VSWR on 12 meters. Stretch the 12 meter coil in increments of 1/4 in (6.4 mm) or so to raise the resonant frequency, or compress the coil a like amount to lower the resonant frequency.

CHECKOUT AND ADJUSTMENT

10. Check VSWR on 6 meters. To raise the frequency of the lowest VSWR, shorten the length of the wire and to lower frequency increase the wire length. Alternatively, the upper clamp and the entire 6 meter assembly may be placed higher on the antenna to lower frequency or lower to raise it.

11. Adjustments for 40, 30, 20, 15, 17, 12, 10 and 6 meters should have little or no effect on the previous adjustments for 80/75 meters, but a final VSWR check for this band should be made as in step 1 above.

NOTE: In above-ground installations it will usually be found that resonance and lowest VSWR occur at slightly higher frequencies on all bands compared to ground-level installations. Therefore on 15 and 10 meters, where length adjustment is the means of getting antenna resonance, it is recommended that the length of the stranded-wire between wire clamp 0.500" 15 M w/wire (L) and wire clamp 0.875" 15 M w/insulator (K) be increased approximately 3 in (7.6 cm.) and that tube (J) be extended approximately 6 in (15.2 cm.) beyond the original dimensions given if any above-ground installation is contemplated. These are merely recommended preliminary settings, for it is impossible to indicate precise settings that will produce resonance or lowest VSWR at a given frequency in all installations.

In the preceding steps it has been assumed that the antenna has been installed in a more or less clear spot away from other vertical conductors such as TV antenna feedlines, towers and masts, and that a minimal ground system (or a system of resonant radials in the case of above-ground installations) has been installed.

If those fairly basic conditions have not been met it is likely that resonance and low VSWR will be impossible on some or even all bands. One should bear in mind that VSWR, even with a resonant antenna, will depend in large measure on local ground conductivity, height above ground in the case of an elevated antenna, the extent of the radial, counterpoise or other ground system used, and on other factors over which the operator may have little or no control. Fortunately, the evils of VSWR greater than unity have been grossly exaggerated in recent decades, and the only practical difference between a VSWR of unity and one of, say, 3:1 in the average case lies in the reluctance of modern equipment to deliver full power into lines operating at the higher VSWR without the help of a transmatch or other outboard matching device. Transmitters having so-called broadband solid-state output circuits (no tuning or loading controls) may be especially troublesome in this regard, whereas the older vacuum tube pi-network transmitters can usually be adjusted for maximum output over a tuning range where the VSWR does not exceed 2:l.

THEORY OF OPERATION

The first L/C circuit generates enough reactance to bring the whole HF9V to resonance on 80 meters allowing it to act as a 1/4 λ radiator. It also generates enough *capacitive* reactance to produce another discrete resonance at about 11 MHz. The second, 40 meter L/C circuit generates enough reactance to resonate the whole HF9V allowing it to act as a 1/4 λ radiator. In order to minimize conductor and I^2R losses an 80 and 40 meters where the antenna is physically shorter than a 1/4 λ and thus operates with lower values of radiation resistance, large-diameter self-supporting inductors and low-loss ceramic capacitors are employed. Where the height of the HF9V is slightly greater than a 1/4 λ on 30 meters, an L/C series tuned circuit taps onto the 40 meter coil for the extra inductance to pull the earlier 11 MHz secondary resonance down to 10 MHz. At the same time, a portion of the 40 meter coil is shorted out which allows the circuit to resonate on 30 meters The addition of this circuit also produces additional resonances at 14 MHz and 28 MHz. On 20 meters the entire radiator operates as a 3/8 λ vertical with much higher radiation resistance and VSWR bandwidth than conventional or *trapped* antennas having a physical height of 1/4 λ or less. Because the 20 meter radiation resistance will be several times greater than that of conventional vertical antennas, an electrical 1/4 λ section of 75-ohm coax is used as a *geometric mean* transformer to match the 100-odd Ω of feedpoint impedance on that band to a 50 Ω main transmission line of any convenient length. The HF9V operates as a slightly extended 1/4 λ radiator on 15 meters, a 1/4 λ stub decoupler providing practically lossless isolation of the upper half of the antenna on that band. On 10 meters the HF9V becomes a 3/4 λ radiator with considerably greater radiation resistance and efficiency than 1/4 λ trapped types. On 17 and 12 meters the coils act as *packets of reactance* which allow the entire radiator to operate as a 1/2 λ or 5/8 λ vertical. Capacitance for these circuits comes from what exists between the windings, the windings and the radiator and the capacitance hat. On 6 meters the vertical wire together with the adjacent section of antenna form a short-circuited 1/4 λ transmission line which cancels current flow. At the lower, open end of the 1/4 λ section a very high impedance is created the effectively divorces the upper part of the antenna leaving the lower section to radiate as a 3/4 λ vertical.

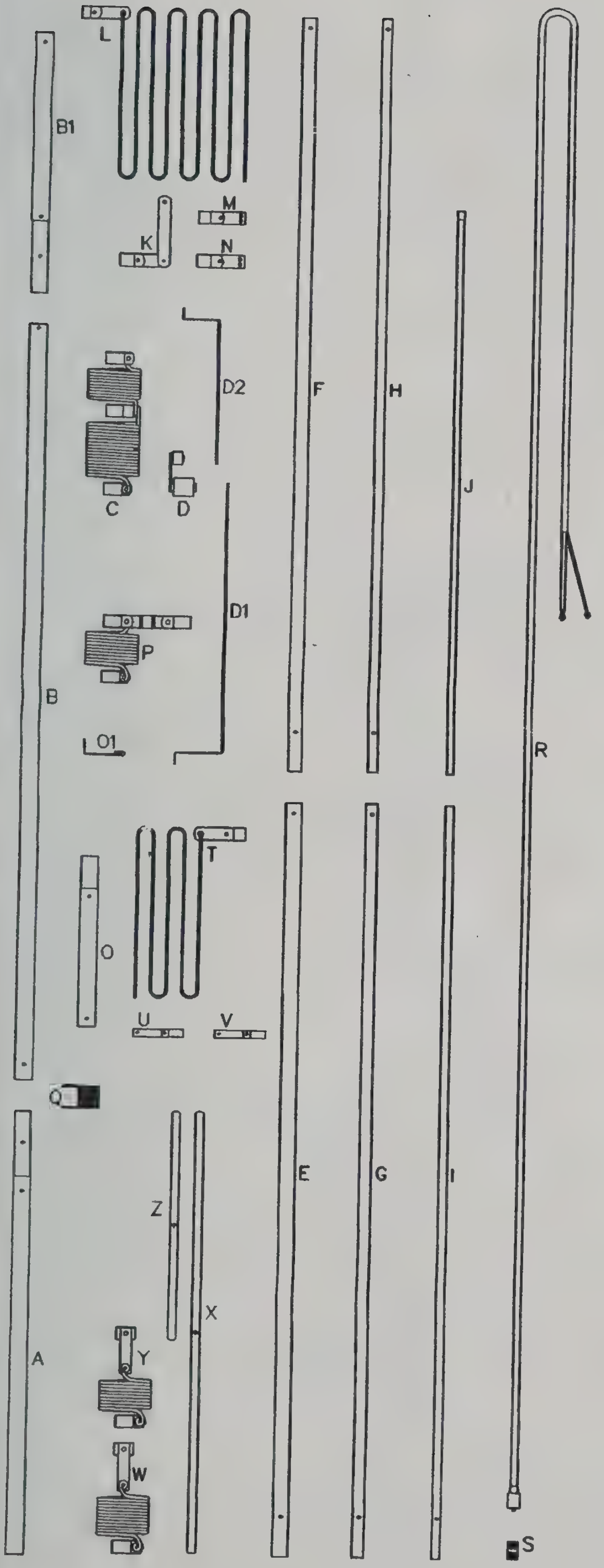
ELECTRICAL AND MECHANICAL SPECIFICATIONS

Height (adjustable): 26 ft (7.9 m)
Shipping Weight: 14 lbs (6.3 kg)
Feedpoint Impedance: Nominal 50 ohms through included matching line.
VSWR at resonance: 1.5:1 or less all bands
Power rating: 2 kW PEP 75/80, 40, 20, 15, I0 meters; 800 W PEP 17, 12 meters; 500 W PEP 6, 30 meters
Wind loading area: 2.2 ft^2 (.2 m^2)
Bandwidth for VSWR of 2:1 or less: 1 MHz 6 meters, entire band 10, 12, 15, 17, 20, 30 meters, 250-300 kHz 40 meters, 40-100 kHz 75/80 meters

GUYING

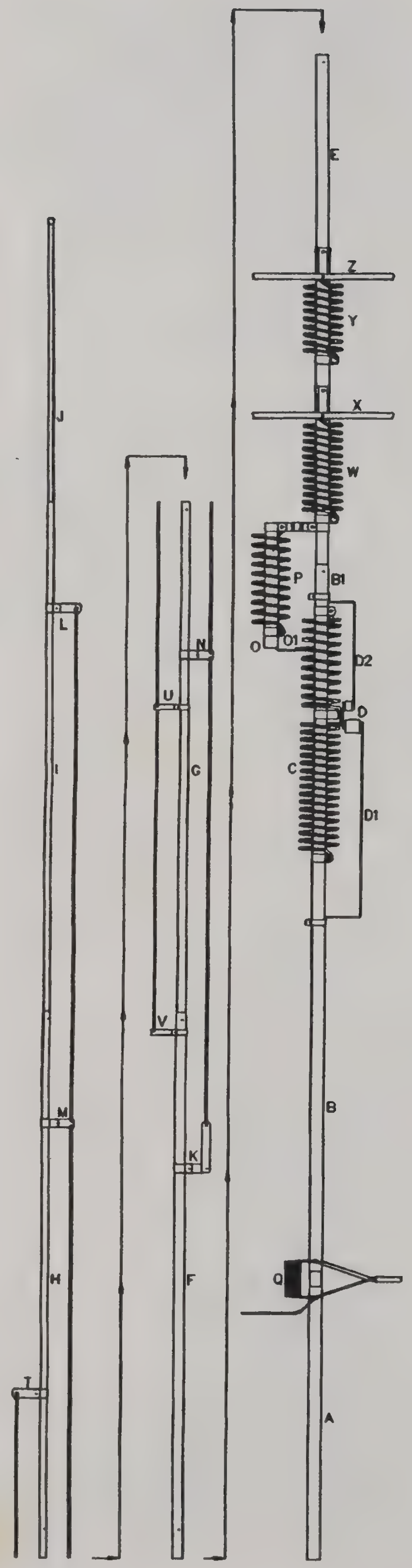
The HF9V is designed to survive winds of up to 80 mph (129 kph) without guying in the absence of ice loading or heavy precipitation, but over a period of time it is to be expected that frequent or even constant flexing or vibration will reduce the chances for survival in winds that would not damage a newly installed antenna. Therefore in areas of frequent or heavy winds a set of short non-conductive guys should be used to reduce the stresses that wind loading will impart to the lower sections of the antenna. In this connection, it should be noted that light nylon twine is totally unsuitable as guying material because it has too much stretch per unit length, although the heavier sizes of nylon rope (or even sash cord) may be suitable if used in short runs. Polyethylene rope may be used, but because some grades tend to deteriorate fairly rapidly, periodic inspection should be made. A single set of guys placed just above the 30 meter circuit will contribute greatly to the stability and the longevity of the antenna, provided that the guys retain a slight amount of slack and do not come off at too steep an angle. At Angles of less than 45° the guys begin to exert a downward compressive force on the structure that can be more of a threat to survival than lateral wind loading on an unguyed structure. Under no circumstances should guys be placed higher than one-third of the way up the antenna. The upper two-thirds of the HF9V has little more than its own weight to support, so these sections may be allowed to bend with the wind with no serious risk of damage. It is the lower third of the antenna that must support both the weight of the upper sections and the wind loading on them and are thus more likely to receive damage in severe winds.

PARTS LIST

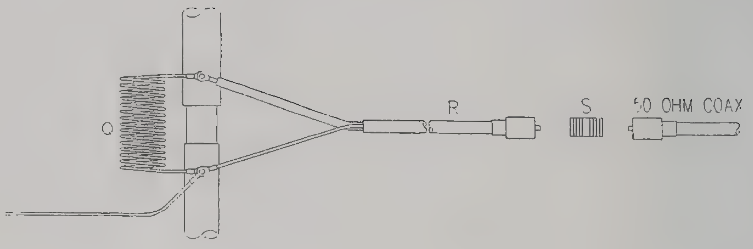


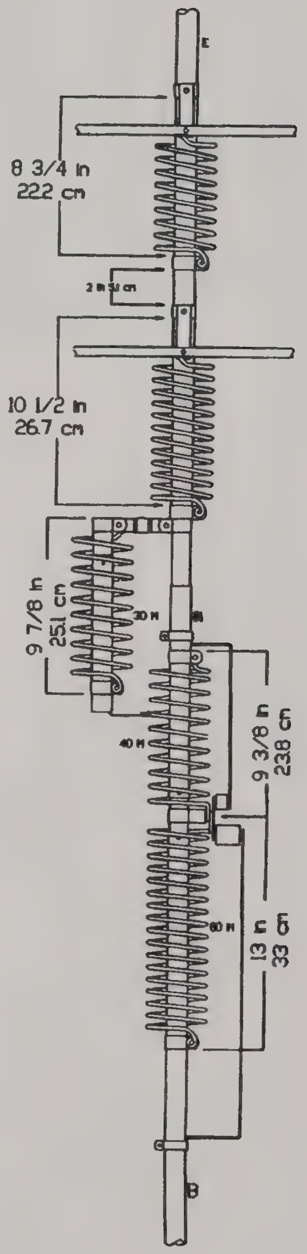
A	00278SZV	Tube A W/Insulator (1-1/8" X 24")
B	00115BAV	Tube B (1-1/8" X 48")
B1	00365SZV	Tube B1 W/Insulator (1-1/8" X 12")
C	00145SZV	Coil Assembly 80/40 Meter
D	290-07	Capacitor Assembly 80/40 Meter
D1	00150BAV	Capacitor Bracket 80 Meter
D2	00220BAV	Capacitor Bracket 40 Meter
E	00123BAV	Tube 1" x 48"
F	00124BAV	Tube 7/8" x 48"
G	00125BAV	Tube 3/4" x 48"
H	00126BAV	Tube 5/8" x 48"
I	00127BAV	Tube 1/2" x 48"
J	00175BAV	Tube 3/8" x 36"
K	00286RZV	Wire Clamp 7/8" 15 M W/Insulator
L	00280RZV	Wire Clamp 1/2" 15 M W/Wire
M	00281RZV	Wire Clamp 5/8" 15 M W/Insulator
N	00282RZV	Wire Clamp 3/4" 15 M W/Insulator
O	00204SZV	Coil Support Tube 30 M (1-1/8" X 9")
O1	00176BAV	Coil Support Tube 30 Meter L Bracket
P	00249SZV	Coil/Capacitor Assembly 30 Meter
Q	00137SZV	Coil Q Base Matching
R	290-08	Coax 75 Ohm Matching
S	00228GZV	Connector PL-258
T	00331RZV	Wire Clamp 5/8" 6 M W/Wire
U	00332RZV	Wire Clamp 3/4" 6 M W/Insulator
V	00314RZV	Wire Clamp 7/8" 6 M W/Insulator
W	00503SZV	Coil Assembly 17 Meter A-17-12
X	00215BAV	Strip 17 Meter
Y	00258SZV	Coil Assembly 12 Meter A-17-12
Z	00216BAV	Strip 12 Meter
		HARDWARE
2	00077JZV	# 8 x 3/4" Screw
5	00078JZV	# 8 x 1" Screw
2	00079JZV	# 8 x 1-1/4" Screw
2	00114JZV	# 8 x 1-1/2" Screw
1	00109JZV	# 8 x 2" Screw
16	00080JZV	# 8 Lock Washer
6	00083JZV	# 8 Flat Washer
16	00081JZV	# 8 Hex Nut
1	00131JZV	#10 x 1" Screw
7	00133JZV	#10 Lock Washer
7	00132JZV	#10 Flat Washer
3	00134JZV	#10 Hex Nut
4	00135JZV	#10 Wing Nut
1	00089FZV	Protective Cap 3/8"
2	00143BAV	Capacitor Bracket Clamp
1	00144JZV	Compression Clamp Small Adjustable
.05	00050DZV	Konnektor-Kote (1" x 8")

PICTORIAL



Feedline Detail





TECH NOTES—GROUND RADIAL SYSTEMS

MOUNTING TUBE INSTALLATION

When tube w/insulator (A) is ground mounted, it should be protected against corrosion if placed in concrete, damp acidic or alkaline soil. Asphalt roofing compound, polyurethane varnish or other sealant that protects against moisture may be used.

Concrete may be used in areas of high winds for greater strength, in which case the post may be twisted slightly during setting for easy removal later.

Tube w/insulator (A) must be installed in a hole approximately 21 in (53.3 cm) deep so that the upper end of the fiberglass insulator is approximately 7 in (17.8 cm) above ground level. Pack earth tightly around tube w/insulator (A) so that it remains vertical.

NOTE: HAMMERING TUBE W/INSULATOR (A) INTO THE EARTH MAY CAUSE THE INSULATOR TO SPLINTER. If the post must be hammered into the earth, protect the end of the insulator with a block of wood

NOTE: DO NOT USE U-BOLTS TO ATTACH TUBE W/INSULATOR (A) TO A MAST, TOWER ETC. U-BOLTS WILL EVENTUALLY CUT INTO THE TUBING AND WEAKEN THE INSTALLATION. If U-bolts must be used, place a larger diameter metal, such as the MPS Mounting Post Sleeve over tube w/insulator (A). Similar precautions should be observed when using TV style towers with locking bolts.

The RMK-II Roof Mounting Kit includes the MPS as well as the STR-II Stub Tuned Radial Kit.

GROUND MOUNTING

A vertical antenna in its simplest form, is electrically equivalent to one-half of a dipole antenna stood on end. When the antenna is mounted close to the ground, the earth below takes the place of the "missing" half of the dipole. If ground conductivity is fair to good, a short metal stake or rod may provide a sufficiently good ground connection for resonant and low SWR operation on the bands for which the antenna is designed. This basic arrangement is shown in figure 1.

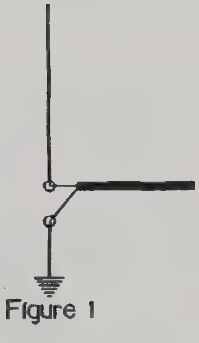


Figure 1

The way it works is that the capacitance between the vertical radiator and the ground causes *return* currents to flow along the earths surface back to the transmitter. If they have to come back along untreated lossy earth thy get back to the source greatly attenuated. This *return* loss is like a resistor in series with the antenna radiation resistance and will therefore affect the feed point impedance.

TECH NOTES—GROUND RADIAL SYSTEMS

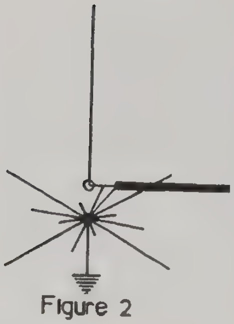


Figure 2

In almost every case the efficiency of a vertical antenna will be greater if radial wires are used to improve ground conductivity as in figure 2. It's important to note that there's no point in cutting radials to any particular length when ground mounting because the earth will detune them anyway. All you want to do is make the surface of the earth around the antenna more conductive than it is ordinarily.

If you can't copper-plate the backyard, the best approach is to run out as many radials as possible, each as long as possible around the antenna in all directions. Radials may be left on top of the ground however they should be buried for the sake of pedestrians and lawnmowers.

How long should radials be? A good rule is no shorter than the antenna is tall because 50% of your losses will occur in the first 1/4 λ out from the antenna. If you have more than a dozen radials, they must be longer to get the most out of them which is why the FCC specifies 113 wires each .4 λ for AM broadcast stations—the equivalent of a zero-loss ground plane. Obviously, for most ham work this would be overkill.

In some cases wire mesh (i.e. chicken wire) may be used as a substitute for radial wires and/or a ground connection, the mesh or screen acting as one plate of a capacitor to provide coupling to the earth beneath the antenna.

It should be noted that a ground rod is useful only as a d.c. ground or as a tie point for radials. It does little or nothing to reduce ground losses at r.f. regardless of how far it goes into the ground.

Bare wire, insulated, any gauge, it doesn't matter. The current coming back along any one wire won't amount to that much.

EFFICIENCY

The importance of reducing losses in the ground system can be seen from an examination of a vertical antenna's feedpoint impedance which at resonance consists of three components: antenna radiation resistance; conductor loss resistance; and earth loss resistance. An unloaded quarter-wave vertical antenna has a radiation resistance of about 35 ohms with negligible ohmic or conductor loss, but ground loss resistance may be very great if no measures are taken to reduce it, and in some cases ground loss R may even exceed the antenna radiation resistance. These three components may be added together to arrive at the feedpoint **impedance** of a **resonant** (no reactance) antenna. For the sake of illustration, assume that the ground loss beneath a quarter wavelength vertical antenna is 15 ohms, that conductor loss resistance is zero, and that the radiation resistance is the textbook figure of 35 ohms. The feedpoint impedance would then be 15+0+35 = 50 ohms, and the antenna would be perfectly matched to a 50 ohm coaxial line. Since the radiation resistance is an index of the amount of applied power that is consumed as useful radiation rather than simply lost as heat in the earth or in the conductor, the radiation resistance must be kept as high as possible in relation to the total feedpoint impedance for maximum efficiency. Efficiency, expressed as a percentage, may be found by dividing the radiation resistance by the total feedpoint impedance of a resonant antenna, so under the conditions assumed above our vertical antenna would show an efficiency of 35/50 = 70%. As a vertical antenna is made progressively shorter than one-quarter wavelength the radiation resistance drops rapidly and conductor losses from the required loading inductors increase. A one-eighth wave inductively loaded vertical would have a radiation resistance of something like 15 ohms and coil losses (or trap losses for multiband antennas) would be in the range of 5 ohms. Assuming the same value of ground loss resistance (15 ohms), the feedpoint impedance would become 15 + 5 + 15 = 35 ohms and the efficiency would be 15/35=43%. From the above calculations it is clear that the shorter a vertical antenna must be the less efficient it also must be for a given ground loss resistance. Or to state the matter another way, more elaborate ground or radial systems must be used with shorter verticals for reasonable efficiency. If the ground loss of resistance of 15 ohms from the preceding example could be reduced to zero ohms, it is easy to show that the efficiency of our one-eighth wavelength loaded vertical would increase to 75%. Unfortunately, more than 100 radials each one-half wavelength long would be required for zero ground loss, so lower efficiencies with shorter radials must usually be accepted for the sake of convenience. In spite of their limitations, short vertical antennas over less than ideal ground systems are often more effective DX performers than horizontal dipoles which must be placed well above the earth (especially on the lower bands) to produce any significant radiation at the lower elevation angles. Verticals, on the other hand, are primarily low-angle radiators on all bands.

ABOVE GROUND (ELEVATED) INSTALLATIONS (rooftop, tower, mast. etc.)

The problem of ground loss resistance may be avoided to some extent by mounting a vertical antenna some distance above the earth over an artificial ground plane consisting of resonant (usually 1/4 λ) radial wires. Four resonant radials are considered to provide a very low-loss ground plane system for vertical antennas at base heights of 1/2 λ or more. This arrangement contrasts favorably with the more than 100 radials for zero ohms loss resistance at ground level, and since 1/2 λ is only about thirty-five feet at 20 meters, very worthwhile improvement in vertical antenna performance can be realized, at least on the higher bands, with moderate pole or tower heights. At base heights below 1/2 λ more than four radials will be required to provide a ground plane of significantly greater conductivity than the lossy earth immediately below the antenna: even so,

TECH NOTES—GROUND RADIAL SYSTEMS

a slightly elevated vertical with relatively few radials may be more effective than a ground-level vertical operating over a larger number of radials if only because the former is apt to be more in the clear. Resonant radial lengths for any band may be calculated from the formula:

$$Length\ (ft) = \frac{240}{Frequency\ (MHz)}$$

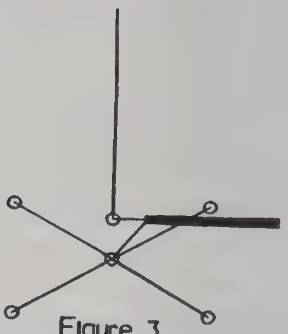


Figure 3

Figure 3 shows the basic ground plane system for elevated verticals. Radials may slope downward as much as 45 degrees without any significant effect on operation or performance. Radials for different bands should be separated as much as possible and the far end of each radial insulated from supporting wires. Figure 4 shows a ground plane system that uses four resonant radials for 40 meters, another set of four for 20 meters, and a third set for 10 meters. A separate set for 15 meters is not ordinarily required because the 40 meter radials operate as resonant 3/4 λ radials on that band. At the lower heights the separate wires of this system may provide enough capacitance to ground to permit low SWR operation on 80/75 meters as well, but it is probable that at least one resonant radial will be required for low SWR on that band. It's important to note that cutting each conductor of rotator cable to a specific frequency will not work unless you separate it, angling each conductor away for most of its length because the longer ones will detune the shorter ones.

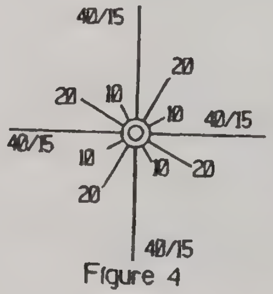


Figure 4

The 12-radial system of Figure 4 is a very good one, but it requires at least 12 tie-off points. Butternut has developed a multiband radial made of 300-ohm ribbon that resonates simultaneously on 40, 20, 15 and 10 meters. Four such radials offer essentially the same ground plane performance as the system of Figure 4 but require only 4 supports. These multiband radials plus additional wire for an 80 meter radial are available separately (our STR-II kit) or as part of the Butternut roof mounting kit (RMK-II).

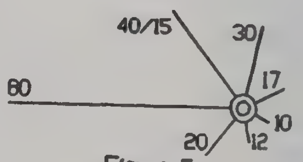


Figure 5

There are times when physical restrictions will dictate the use of fewer than four radials, and at least one manufacturer recommends 2 radials per band, the radials for each band running 180 degrees away from each other. A simpler (and no doubt less effective) system is shown in Figure 5. Since only one resonant radial is used per band the antenna will radiate both vertically and horizontally polarized energy, and the pattern will not be completely omnidirectional. For true ground plane action and predominantly vertical polarization no fewer than three equally-spaced radials should be used.

TECH NOTES—GROUND RADIAL SYSTEMS

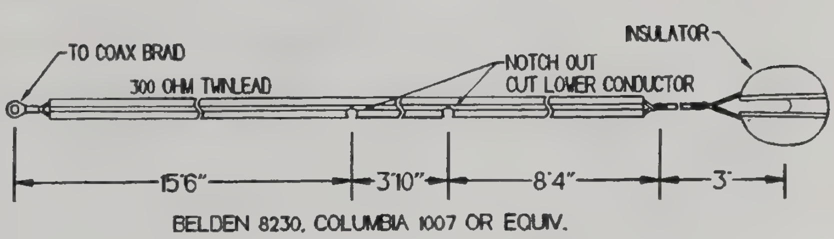


Figure 6

Figure 6 illustrates the construction of a multi-band radial which is resonant on 40, 20, 15 and 10 meters. Good quality 300 ohm TV ribbon lead should be used (velocity factor is critical), and the conductors should employ at least one strand of steel wire to support the weight of the radial. Four such radials will be the practical equivalent of the system shown in figure four for operation on 40 through 10 meters.

Regardless of the number of radials used in either elevated or ground level systems, all radials should be attached to the ground connection at the antenna feedpoint by the shortest possible leads. An elaborate radial system at ground level, for example, cannot be used with a vertical antenna on a rooftop or on a tall tower, for the length of the ground lead would effectively become part of the antenna, thus detuning the system on most or all bands.

METAL TOWERS AND MASTS

If a metal mast or tower is used to support a vertical antenna all radials should be connected to the mast or tower at the ground connection of the antenna feedline. This is because one of the functions of a resonant radial is to detune a supporting metal structure for antenna currents that might otherwise flow on the structure and thus turn the vertical antenna system into a vertical long wire with unwanted high-angle radiation.

OTHER MOUNTING SCHEMES

In cases where a resonant vertical antenna may neither be ground mounted nor used with an elevated ground plane, operation may still be possible if connection can be made to a large mass of metal that is directly connected or capacitively coupled to the ground, e.g., central air conditioning systems or structural steel frames of apartment buildings. Some amateurs have reported good results with vertical antennas extended horizontally or semi-vertically from metal terraces which serve as the ground connection. Alternatively, a quarterwave vertical may be window mounted if a short ground lead to a cold water pipe or radiator can be used. If a long lead must be used, tuned radials may be required for resonance on one or more bands. Great care should be exercised in such installations to avoid power lines and to keep the antenna from falling onto persons or property.

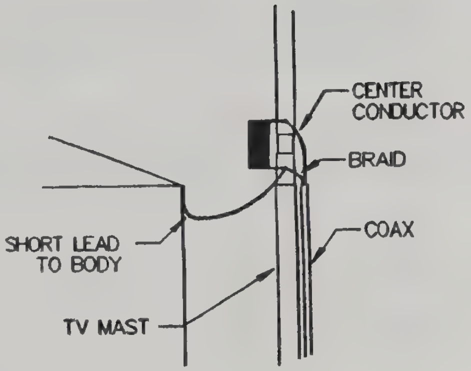
MOBILE HOME AND RV INSTALLATION

The principles of vertical antenna installations for use on mobile homes or RV's are the same as for other installations, and they all boil down to two main considerations. The first is that of erecting the vertical in the clearest possible spot, away from obstacles (including the MH or RV) that can interfere with radiation from the antenna. The second is that of installing the beat possible ground system beneath the antenna in order to minimize losses from r.f. currents flowing in the earth below the antenna. Fortunately, the metal bodies of both MHs and RVs can be used as highly conducting ground planes for vertical antennas in exactly the same way that automobile bodies, etc., provide the ground system for shorter vertical antennas for mobile operation. The metal body of an automobile, MH or RV may be viewed as one plate of a capacitor. Since the surface area of even a small automobile is quite large and in close proximity to the earth, its body is tightly coupled to the earth below and may be considered simply as an extension of the earth itself—a kind of hill as far as radio frequencies are concerned, but one having higher conductivity than the earth itself. RVs and especially MHs, having much greater surface area, will therefore provide a more extensive and effective ground system than a large number of radial wires occupying the same space as the MH or RV.

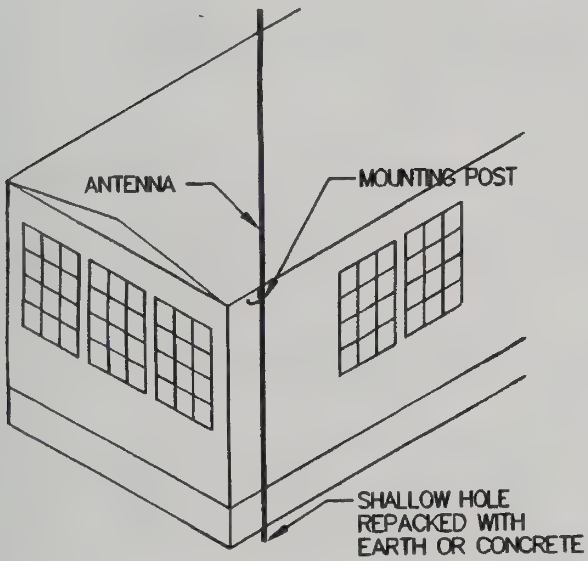
As in mobile installations, a vertical antenna may be mounted almost anywhere on the body of the vehicle or MH and made to operate with reasonably low VSWR, but it is generally considered that the best possible location for a mobile antenna is in the middle of the roof of the vehicle, i.e., at the center of the vehicle's ground plane and at a point where the antenna will not be in the "shadow" of any part of the vehicle. It is not usually convenient, or even practical to install a relatively tall vertical on the roof of an RV or MH for any number of reasons, so the next best procedure would be to install a vertical antenna with its base at the same level as the roof, preferably near the middle of one of the longer sides. The exact way in which this may be done is a matter of convenience, but a short mast extending from ground level to the roof of the MH and RV and placed alongside the building or RV would provide a stable and sturdy support with a minimum of mounting brackets and other modifications to the RV or MH. For portable operation such a mast could simply be lashed alongside the RV with the base in a shallow hole in the ground for additional support, and there would be no harm in extending the mast a few inches above the roof level to permit attachment of ropes which could be used to hold the mast firmly against the side of the vehicle and to prevent side sway.

This system has been used successfully with various types of RVs, travel trailers and even passenger automobiles during portable operation. For "L" shaped mobile homes a vertical antenna should be placed in the corner of the "L" so that the metal roof will provide groundplane coverage over 270 degrees.

TECH NOTES—GROUND RADIAL SYSTEMS



In all cases the base of the vertical antenna should not be more than a few inches away from the MH or RV so that the shortest possible lead may be run from the ground connection of the antenna to the metal body, as the length of this ground lead will effectively lengthen the antenna itself on all bands, and detuning can occur in some cases. A good electrical connection between the body of the RV or MH and the antenna is important, and in the case of mobile homes it would be a good idea to make sure that good electrical contact exists between the different parts of the metal body. Discontinuities can often lead to the production of harmonic radiation and TVI. The essential circuit connections are shown in the diagram above.



For permanent installations the bottom of the mast may be set deeper in the ground, and concrete may be used for greater strength and stability. The upper portion of the mast should be securely attached to the side of the building. Steel TV mast sections are readily available in lengths of ten feet and the mounting posts of Butternut HF verticals will slide into those which have an outside diameter of 1 1/4 inches and a wall thickness of .058 inches. Other vertical antennas may use different mounting techniques and requirements, so be sure to select a mast that will be suited to the particular situation. The main point to keep in mind is that the mast should not extend more than a few inches above the level of the roof so that the ground lead may be kept short.

LIGHTNING PROTECTION

Modern solid state amateur equipment is particularly vulnerable to damage from lightning or static induced transients that may appear on transmission lines, and conventional air-gap lightning protectors may provide no real protection at all for solid state gear. A line of very effective lightning and static protectors has been developed by ALPHA DELTA COMMUNICATIONS, P.O. Box 571, Centerville, Ohio 45459, for use with solid state equipment, and since these devices feature much faster transient discharge times than earlier designs, they should be investigated for possible use with all vertical and other antenna systems.

TROUBLESHOOTING

Check out your installation again, looking for loose connections and checking all dimensions. Then refer to the list of possible symptoms below:

Symptom: Few or no signals heard: bands seem *dead*, SWR is very high.
Look for: Open or shorted feedline, open or shorted matching line, broken connection at base of antenna (feedpoint).

Symptom: High SWR on 20 meter; other bands OK.
Look for: Missing matching line. Antenna not properly tuned. 20 meter radials not present or wrong length. Consult instructions for tuning and radial information; install matching line *RG-11 75 ohm coax, 11 ft 4 in (345.4 cm) if solid dielectric, 13 ft 6 in (411.5 cm) if foam type.*

Symptom: High SWR on some bands, but signals heard on all bands (conditions permitting).
Look for: Missing or defective radial system. Install as per instructions and check connections to radials and ground system. Keep this connection 6 in or less.

Symptom: High SWR on one band when antenna is roof-mounted. Radials are in place, but antenna will just not tune.
Look for: Radials of wrong length or running close to metal rain gutters or roof flashing. Tune radials and/or reroute them away from metal.

Symptom: Tuning is *sharp* with narrow bandwidth on 80 meter (and 160 meter if TBR-160-S is in place).
Look for: Normal condition. The total length of the antenna represents such a small percent of a wavelength on these bands that sharp tuning is a normal condition.

Symptom: Antenna was installed on the ground and tuned OK, but tuning changed over a period of weeks or months.
Look for: Antenna installed over poor ground system. Ground conditions have changed, causing shift in resonance. Install radial system as per instructions. Check connection to radial system. When you see this problem, you may assume that a ground rod without a radial system is not enough.

Symptom: Resonant point changes during wet weather.
Look for: Normal condition.

Symptom: Insulation arcs over between 80 meter and 40 meter coils damaging fiberglass.

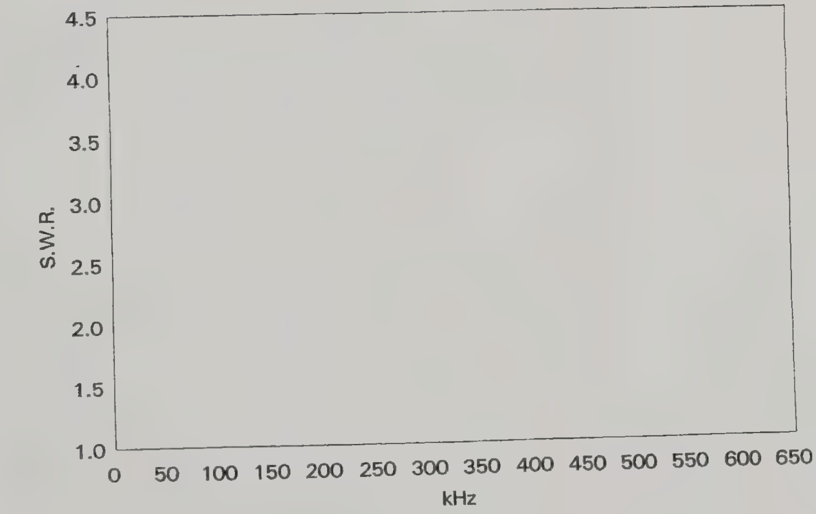
TROUBLESHOOTING

Look for: Operation at high power levels in areas where salt or pollution deposits have built up on the insulators. The cure is to keep insulators clean through routine maintenance.

Symptom: Intermittent operation. SWR jumps up and down suddenly, and reception is also intermittent.
Look for: Loose connections in the feedline or matching line (if used). Bad relay in rig. Bad antenna switch or connecting cable. Broken or corroded connections at the feedpoint. Bad radial/ground connection. Radial or antenna contacting metal when wind blows. Loose hardware on the antenna. Check and secure all connections.

Symptom: Antenna displays generally degraded performance after long period of time.
Look for: Lack of routine maintenance. Coax may be waterlogged or damaged. Build up of salt or pollution deposits on insulators and capacitors. Radial system corroded or rotted away. Owner must do routine maintenance at intervals, according to local conditions.

Symptom: SWR is OK on 75 meter, but goes up gradually when high power is applied. This is accompanied by heating of 200pF capacitor.
Look for: Bad ceramic capacitor. Replace.



Symptom: Antenna doesn't tune 80 meter or 160 meter, even though radials are in place and of proper length.
Look for: Antenna far out of tune; operator has not followed systematic tuning procedure. Start with suggested settings in instructions. Make an SWR chart to determine point of resonance. Adjust coils *carefully!* Remember, tuning, is *sharp* on these bands, so it is easy to pass the resonant point, then assume erroneously that the antenna isn't tuning.

BEFORE you call the manufacturer for help, please double check your installation, including all connections and dimensions. Tune carefully and systematically. Have SWR curves available. Be prepared to describe your installation in detail.

BUTTERNUT ELECTRONICS COMPANY
405 EAST MARKET STREET
LOCKHART, TEXAS 78644
(512) 398-7117

ASSEMBLY AND TUNING INSTRUCTIONS
Model A-18-24 (17 and 12 meter
conversion kit for Models HF5V-III,
HF6V and HF6V-X antennas
(copyright 1988)

The A-18-24 conversion kits consists of two capacitor, clamp and rod assemblies for the 17 and 12 meter bands, each assembly forming a parallel-resonant circuit "trap" circuit that limits current flow to the first quarter-wave portion of the radiator on each band without, however, requiring that the radiator be broken by insulators. Further, the high ratio of capacitance to inductance in each circuit greatly reduces the loading contributed by each circuit on the lower-frequency bands so that addition of the A-18-24 to existing 5- or 6-band units will not upset adjustments that have already made for the other bands.

PARTS LIST:

Quantity

1---ceramic capacitor mounted on double-clamp assembly (one large to fit 1" or 7/8" O.D. tubing--tighten as needed--and one small clamp for 3/16" rod

1---ceramic capacitor mounted on double-clamp assembly for 3/4" O.D. tubing and 3/16" rod

1---double clamp for 1" tubing and 3/16" rod

1---double clamp for 7/8" tubing and 3/16" rod

1---double clamp for 3/4" tubing and 3/16" rod

1---3/16" rod 24"/61 cm. long

1---3/16" rod 36"/91 cm. long

Note: only two of the all-metal double clamps will be needed, and which two will depend on the particular model and series.

HARDWARE: attached to above parts

ASSEMBLY: (refer to drawing)

1. Measure up 123 inches/3.124 meters from the antenna feedpoint and place the appropriate all-metal double clamp around the tubing at that point. Measure up another 18.5 inches/47 cm. from that point and attach the double-clamp capacitor assembly for 1" or 7/8" tubing. Align the small end of the all-metal clamp and the small end of the capacitor clamp, pass the 24-inch x 3/16" rod through them, and tighten the hardware--not too tight, for later adjustment may be necessary. The excess rod material may extend below the lower clamp or above the upper one for the time being. This is the preliminary setting for the 24 mHz circuit.

2. Measure up 15.5 inches/39.4 cm. from the capacitor clamp for the 24 mHz circuit and place either the 7/8" or 3/4" all-metal clamp on the antenna at this point, the small end of the clamp pointing away from the 15 meter decoupling stub. Place the remaining capacitor clamp 35.25 inches/89.5 cm. above the upper edge of the all-metal clamp (also pointing away from the 15 M decoupling stub) and inset the 36" 3/16 ROD INTO THE SMALL END of EACH CLAMP. TIGHTEN THE HARDWARE. THIS IS THE PRELIMINARY SETTING for THE 18 mhz CIRCUIT.

FINAL ADJUSTMENT:

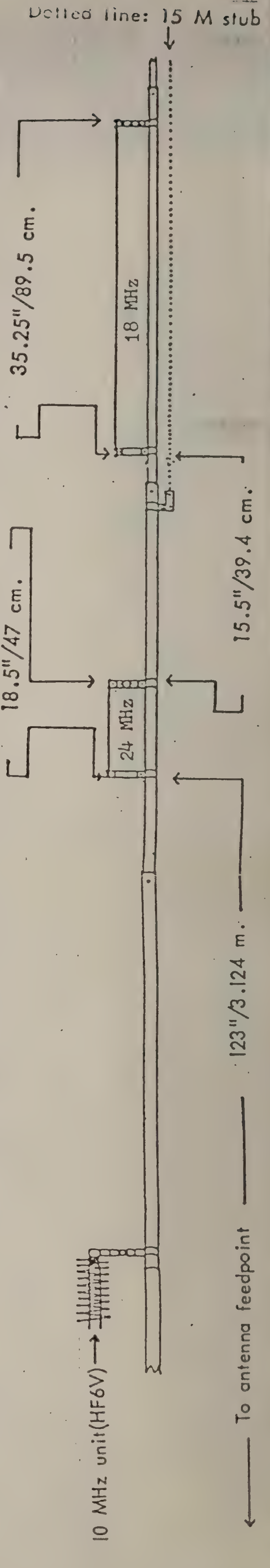
The above settings should provide reasonably low SWR over the 17 and 12 meter bands and should be entirely satisfactory for SWL work in those areas where amateur operation on these bands is not yet permitted. For transmitting purposes, however, SWR of 2:1 or less may be required, in which case slight departures from the above settings may have to be made. It will be found that tuning on 17 and 12 meters is quite a bit sharper than on the other bands and that slight changes is the spacing between the upper and lower clamps of each unit will cause the SWR curve to move considerably. Final adjustment for lowest SWR is covered in the following steps:

1. Construct an SWR curve for each band, plotting SWR vs. frequency. If lowest SWR occurs at the lower edge of either band loosen the hardware of the upper clamp for that band and slide the clamp downward along the antenna and the 3/16" rod in order to decrease inductance and thus raise the frequency of lowest SWR. If, on the other hand, lowest SWR occurs at the upper edge of a band slide the upper (capacitor) clamp upward along the antenna and the 3/16" rod to increase circuit inductance and thus lower the frequency of lowest SWR. In either case, these adjustment should be made in steps of no more than half an inch or so.

2. Please bear in mind that the antenna ground system, regardless of the form it might take, can have a great deal to do with antenna resonance and SWR. Lossy ground systems can cause unusually high feedpoint impedances and high SWR on coaxial lines. Elevated ground systems can be both lossy and reactive, depending on the length of the wires that make them up, their proximity to the earth or to other conductors, and so on. If the ground system is reactive it may be found that the antenna system as a whole is so far from resonance that the SWR may remain unacceptably high across an entire band regardless of the adjustments made to the vertical radiator and its tuning circuits. In general, however, a ground-level radial system or a slightly elevated capacitive counterpoise system that permits low-SWR operation on the other HF bands will also suffice for 12 and 17 meters, although an elevated system that uses resonant radials for the pre-WARC bands only may require additional resonant radials for the new bands. For antenna base heights of a quater-wavelength or more above ground the length of a resonant quarter-wave radial may be calculated from the formula:

   Length (in feet) = 240/Frequency in MHz

   To obtain the correct length in meters simply multiply the result by .3048. A minimum of two resonant radials per band should be used with elevated verticals, and all radials should be separated from adjacent radials by as great a distance as practicable.



BUTTERNUT ELECTRONICS CO.

405 E. Market Street, Lockhart, Texas 78644 Phone: (512) 398-7117

MODEL HF6V

ASSEMBLY AND INSTALLATION INSTRUCTIONS

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PLEASE READ ALL INSTRUCTIONS THOROUGHLY BEFORE PROCEEDING TO ASSEMBLY. DURING ASSEMBLY AND INSTALLATION TAKE EXTREME CARE TO AVOID CONTACTING POWER LINES WITH ANY PART OF THE ANTENNA OR OTHER CONDUCTORS.

DO NOT INSTALL THE ANTENNA IN ANY PLACE WHERE ANY PART OF IT CAN COME INTO CONTACT WITH POWER LINES IN THE EVENT OF STRUCTURAL FAILURE OF ANY PART OF THE INSTALLATION OR IN THE COURSE OF NORMAL FLEXING AFTER INSTALLATION, FOR SUCH CONTACT CAN RESULT IN DAMAGE TO PROPERTY, BODILY INJURY OR EVEN DEATH!

IN NO CASE SHOULD THE ANTENNA BE INSTALLED IN ANY PLACE WHERE STRUCTURAL FAILURE OF ANY PART OF THE ANTENNA OR ITS SUPPORTING SYSTEM CAN ENDANGER PERSONS OR PROPERTY.

CAUTION! A GROUNDED ANTENNA WILL BE AT D.C. GROUND POTENTIAL! TO AVOID THE DANGER OF SHOCK CONNECT ALL STATION EQUIPMENT TO A GOOD EARTH GROUND. IT IS ALSO RECOMMENDED THAT ALL STATION EQUIPMENT BE DISCONNECTED FROM THE POWER MAINS BEFORE CONNECTING THE FEEDLINE TO THE ANTENNA. PLEASE CONSULT THE A.R.R.L HANDBOOK OR OTHER REFERENCE MANUALS FOR ADDITIONAL SAFETY PROCEDURES WHEN WORKING WITH ELECTRICAL EQUIPMENT.

Tools required for assembly: standard blade screwdriver, pliers, knife. A set of nutdrivers will be useful.

REFER TO THE APPROPRIATE DRAWINGS AND DIAGRAMS AND PROCEED AS FOLLOWS:

1. Check to be sure that all parts are present (see parts pictorial page).

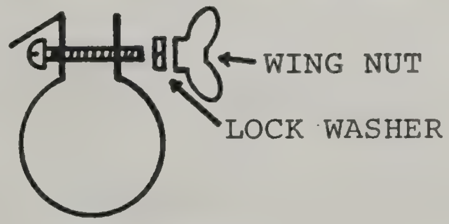
2. If the antenna is to be installed at ground level, plant mounting post A in a hole approximately 21 inches (55 cm.) deep so that the upper end of the fiber glass insulator rod is approximately 5 inches (12 cm.) above ground level. Pack earth tightly around the mounting post so that it will remain vertical. Concrete may be used in areas of high winds for greater strength, in which case the post may be twisted slightly during setting for easy removal later. The mounting post tube should be protected against corrosion if it is to be placed in concrete or in damp, acidic or alkaline soil. Asphalt roofing compound, polyurethane

varnish or any other sealant that protects against moisture may be used. No such protection is required for above-ground and most ground-level installations. NOTE: Hammering the mounting post into the earth may cause the insulator rod to splinter. If the post must be hammered into the earth, protect the end of the rod with a block of wood. If a permanent installation is not desired, a steel or other metallic tube having an inner diameter slightly larger than the outer diameter of section A (1-1/8 inches) may be used, and section A may be inserted into this outer tube for later removal. If the antenna is to be installed in an elevated position rather than at ground level, please refer to the note following step 19 below and to the separate roof mounting kit/radial information.

3. Prepare the impedance matching/d.c. grounding coil (Q) as shown in the pictorial.

4. Locate section B. This consists of two aluminum tubes, a long and a short one, joined by an insulating rod. The longer tube will later be mounted on the rod insulator at the top of section A. It is recommended that all subsequent steps involving section B be done indoors or in an area where dropped hardware may easily be recovered.

5. Locate the 80-40 meter coil assembly (C) and slide the clamp at the outer end of the larger coil over the short tubing end of section B, lowering the entire coil assembly until the middle clamp can be positioned around the fiber glass insulating rod. The middle clamp may have to be pulled open slightly to pass over the tubing and the bolt that goes through the upper tube and the insulator rod. Position the center coil clamp around the insulator rod so that the distance from the clamp to the end of either piece of tubing is approximately equal, and pass a #10 x 1" bolt through the holes of the center coil clamp as shown in the drawing immediately below. The outer tab of this clamp may be bent back slightly to provide clearance for the bolt, and it may be bent back into place after final assembly. Fasten the center coil clamp firmly in place using a split lockwasher and a wing nut. Repeat the procedure for the two remaining coil clamps, tightening the wing nuts only enough to hold the hardware in place. Coil adjustments will be made later.



COIL CLAMP DETAIL

6. Locate the 80-40 meter capacitors (installed on a flat strip

with a large center hole). Install the (longer) 80 meter capacitor bracket (D) on the larger capacitor, using a #10 x 3/8" bolt and lockwasher (see pictorial). Install the (smaller) 40 meter capacitor bracket on the smaller capacitor, using a #6 x 1/4" bolt and lockwasher.

7. Line up the hole in the center of the capacitor strip with the threaded end of the long #10 bolt protruding from the tab of the center coil clamp. Make sure that the long bracket of assembly D runs alongside the larger (80 meter) coil of assembly C. Fasten the smaller center strip of D to the tab of the center coil clamp, using a flat washer, a split lockwasher and a #10 hex nut. Finally, fasten the small tab end of the capacitor assembly firmly against the upper and lower tubes of B by means of the two large non-adjustable compression clamps. These clamps use a #8 x 1" bolt, a split lockwasher and a hex nut. If a flat blade screwdriver is used to tighten the clamps do not grasp the work immediately opposite the blade in order to avoid injury if the blade slips.

8. Locate tubing sections E, F, G, H, I and J as well as clamp and spacer assemblies M and N. Please note that as tubes are assembled the unslotted end of each tube will be pointing downward and the slotted ends will be pointing upward. Slide M over tube H and use the attached hardware to secure M at the approximate center of tube H; slide assembly N to the approximate center of tube G and secure with the attached hardware.

IN THE FOLLOWING STEPS TUBES E THROUGH I WILL BE FASTENED TOGETHER BY MEANS OF #8 HARDWARE (BOLT, SPLIT LOCKWASHER AND HEX NUT). AN 11/32" NUTDRIVER WOULD BE USEFUL BUT NOT NECESSARY. IF A FLAT BLADE SCREWDRIVER IS USED DO NOT HOLD THE WORK OPPOSITE TO THE BLADE IN ORDER TO AVOID POSSIBLE INJURY.

9. Insert the unslotted end of tube F into the slotted end of tube E, align the four holes, and pass a #8 x 1-1/4" bolt through both tubes. Place a split lockwasher and a hex nut on the threaded end of the bolt and tighten snugly.

10. Insert the unslotted end of tube G into the slotted end of tube F and proceed as in step 9, using a #8 x 1-1/4" bolt and hardware.

11. Insert the unslotted end of tube H into the slotted end of tube G and proceed as before, using a #8 x 1" bolt and hardware.

12. Insert tube I into tube H and proceed as before, using a #8 x 1" bolt and hardware.

13. Place the small gear-driven hose clamp over the slotted end

of tube I and tighten only enough to hold the hose clamp in place.

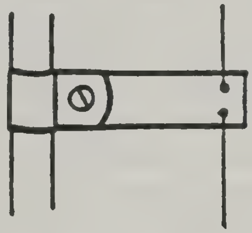
14. Slide the uncapped end of tube J into the slotted end of tube I until only 25 inches (63.5 cm.) extends from the end of tube I. Tighten the hose clamp snugly.

15. Locate clamp L and the attached length of stranded wire. Position clamp L around tube I so that its upper edge is approximately 8.5" (21.5 cm.) from the upper end of tube I. Pass a #8 x 3/4" bolt through the clamp holes and secure firmly with a split lockwasher and a hex nut.

16. Locate clamp K and position it around tube F. Pass a #8 x 3/4" bolt through the clamp holes. Finger tighten, using a split lockwasher and a hex nut. The plastic insulator strip should point upward.

17. Measure from the rivet of clamp L to a point that is 11 ft. 3 inches (3.43 m.) along the stranded wire. Mark this point for future reference.

18. Pass the free end of the stranded wire from clamp L downward through the small holes in spacers M and N as shown in the illustration to the right. M and N may be turned on their tubes so that they line up with clamp L. Loop the end of the wire through the hole in the plastic insulator of clamp K and slide clamp K along tube F until the mark on the wire appears at the small hole in the insulator. Wind the wire back on itself above the insulator to keep the excess out of the way. Do not cut off the excess wire.



19. Line up clamp K with clamp L and spacers M and N. Position clamp K so that the wire is moderately taut but not so tight as to cause the upper tubing sections to bow. This completes assembly of sections E through J. These may be set aside for later installation atop section B.

NOTE: In the following steps the antenna will be assembled and raised to its full vertical height, after which the 30 meter tuning circuit will be installed. If the antenna is to be installed in an elevated position (rooftop, mast, tower, etc.) where it is unsafe or inconvenient to make in-place adjustments, the antenna may have to be installed in one piece, in which case it will probably be necessary to raise and lower it and its supporting structure a number of times to arrive at the "ideal" adjustment on all bands. If so, every precaution should be observed in order to avoid possible contact with power lines and to prevent structural failure that can cause injury to persons or

property. DO NOT USE U-BOLTS TO ATTACH THE TUBULAR MOUNTING POST (SECTION A) TO A MAST, TOWER OR VENT PIPE OR OTHER SUCH SUPPORT, FOR U-BOLTS WILL EVENTUALLY CUT INTO THE TUBING AND WEAKEN THE INSTALLATION. If, however, U-bolts must be used, place a larger-diameter metal tube or other suitable protective material around the mounting post tube. Similar precautions should be observed when using TV-style towers with locking bolts. The Butternut Electronics roof mounting kit (model RMK-II) includes a protective sleeve for the mounting post tube, and this tube is also available separately as model MPS for non-permanent ground-level installations.

20. Place the lower end of section B over the rod insulator of section A and line up the screw holes. Pass a #8 x2" bolt through the holes. Secure with a #8 split lockwasher and hex nut.

21. AVOID POWER LINES! Raise assembly E through J and slide the lower end of E into the slotted end of section B. Align the holes through the two tubes and fasten securely, using a #8 x 1-1/2" bolt and hardware.

22. Locate tube O and 30 meter coil P (O is the short tube with an insulator at one end). Note that the upper end of P is connected to a double clamp assembly that includes a ceramic capacitor. Place a #10 split lockwasher and a wing nut on the bolt through the lower (single) clamp attached to coil P and tighten just enough to hold the hardware in place. Place a #10 lock washer and hex nut on the bolt through the upper clamp that is immediately connected to coil P and tighten just enough to hold the hardware in place. Locate the small "L"-shaped clamp shown in the drawing with O. Fasten this clamp to O by means of a #8 x 3/4" bolt, a split lockwasher and a hex nut.

23. Pass the lower clamp of coil P over the insulator end of tube O and slide the coil downward along the tube until the upper edge of the upper clamp is flush with the end of the insulator. Position the upper clamp so that the entire upper assembly points in the same direction as the "L"-shaped clamp at the bottom of tube O. Tighten the upper clamp securely around the insulator and set the completed O-P assembly aside.

24. From the center of the center clamp of coil assembly C, measure downward to a point that is 13" (33 cm.) along the lower tube of section B. Mark this point and stretch the 80 meter (larger) coil until the lower edge of the bottom clamp is even with the mark. Tighten the wing nut to secure the clamp at this point.

25. From the center of the center clamp of coil assembly C measure upward to a point 9-3/8" (24 cm.) along the upper

tube of section B. Mark this point and stretch the 40 meter (smaller) coil until the upper edge of the upper clamp is even with the mark. Tighten the wing nut to secure the clamp at this point.

26. Take up the assembled 30 meter unit (sections O and P) and position the remaining upper clamp around tube E so that the L-bracket clamp from the lower end of O is even with the fourth turn (counting from the top down) on the 40 meter coil on the upper tube of section B. Use a split lockwasher and a hex nut to tighten this clamp around tube E a slight amount.

27. Hook the L-bracket clamp from tube O around the fourth turn of the 40 meter coil and use small #8 hardware to tighten the clamp securely around the coil turn. Adjust the position of the larger clamp around tube E to avoid distorting the 40 meter coil. Tighten this clamp securely.

28. From the upper edge of the upper coil clamp on assembly P-O measure downward to a point 9-7/8" (25 cm.) along the aluminum tube. Mark this point and stretch the 30 meter coil until the lower edge of the lower clamp is even with this mark. Tighten the wing nut to secure the clamp at this setting. This completes the preliminary adjustment of the 80, 40 and 30 meter coils.

29. Install the 75-ohm matching line (R) on sections A and B as shown in the pictorial. Simply place the lugs over the ends of the #8 bolts at this time. The center conductor connects to section B, the braid to section A.

30. Place #8 flat washers over the lugs and install impedance-matching/d.c. grounding coil Q as shown. Point 1 should go to section B, point 2 to section A, and point 3 to any ground rod or other earth connection. Secure the connection to sections A and B with flat washers, lock washers and hex nuts. Radials or additional grounding may be attached to the connection on section A with the remaining #8 hardware.

31. MAKE SURE THAT THE STATION EQUIPMENT IS CONNECTED TO A GOOD EARTH GROUND! DO NOT HANDLE CABLE CONNECTED TO STATION EQUIPMENT WITHOUT FIRST DISCONNECTING THE EQUIPMENT FROM THE POWER MAINS. YOU COULD BE ELECTROCUTED!

    Connect matching line R to any length of 50-53 ohm coaxial cable. A PL-258 "barrel" connector (S) is provided.

CHECKOUT AND ADJUSTMENT

The dimensions and coil settings given above should produce reasonably low VSWR readings over the entire 10, 15, 20 and 30

meter bands and over at least 250 kHz of the 40 meter band. Bandwidth on 80/75 meters should be at least 30 kHz for VSWR of 2:1 or less at the low end of the band and may be as much as 100 kHz at the high end of the band, depending on the efficiency of the ground system used, greater bandwidth being associated with lossy ground systems. It should be remembered that on those bands where the physical height of a vertical antenna is less than a quarter wavelength, the earth (or the resonant radial system in above-ground installations) will have a good deal to do with VSWR and antenna tuning, bandwidth and overall performance.

Low VSWR by itself does not mean that a vertical antenna is operating efficiently, and if low VSWR is obtained with no more than the usual "quick and dirty" ground connection, it most likely means the opposite. In general, poor operation or improper tuning of vertical antennas can usually be attributed to inadequate (or even reactive) ground systems or to other vertical conductors in the vicinity of the antenna. For these reasons it is suggested that the antenna be placed as much in the clear as possible and used with the best ground system that conditions permit. For a more complete discussion of the inter-relationships between vertical antenna efficiency, bandwidth, VSWR, etc., a standard text such as the A.R.R.L. Antenna Book is recommended. See also the material included at the end of these instructions.

For adjustment purposes a simple VSWR indicator may be used. More accurate measurements may be made at the antenna (i.e., at the junction of the 75-ohm matching line and the main transmission line) than at the input end of the line, but the tuning conditions that exist at the transmitter will usually be of greater interest in that one's principal concern will be to couple power from the transmitter into the transmission line.

1. Determine the frequency at which VSWR is lowest on 80/75 meters. The coil setting given earlier should produce resonance and lowest VSWR at approximately 3700 kHz. To raise the frequency of resonance and lowest VSWR, simply loosen the wing nut on the lower coil clamp of the lower (80 meter) coil on section B and stretch the coil a bit more. To lower the frequency, compress this coil. A one-inch change in the setting of this coil will produce a frequency shift of approximately 125 kHz. Remember that the antenna tunes very sharply in this range and that high values of VSWR may be encountered only a few kHz either side of the lowest VSWR readings, so it would be well to take VSWR readings every 25 kHz or so to avoid "running past" the frequency of resonance and lowest VSWR. To minimize interference to other stations and to avoid erroneous readings use only enough power to produce full-scale deflection of the meter in the "forward" or "r.f. out" position. Once the proper coil setting has been found for the desired band segment, coil Q at the base of the antenna

may be adjusted for even lower VSWR. If earth losses are moderate to high a good match may be possible if coil Q is left fully compressed; if earth losses are low (as with an extensive radial system) coil Q may have to be stretched to twice its compressed length or more for a good match. In any case, a single setting for coil Q should suffice for operation over most of 80/75 meters provided the 80 M coil is readjusted for each different band segment.

2. Determine the frequency of minimum VSWR on 40 meters. The coil setting given earlier should produce resonance and lowest VSWR at approximately 7150 kHz. The 40 meter VSWR and resonance curve may be shifted in the same manner as on 80/75 meters by changing the setting of the upper coil clamp on section B. On this band the setting is much less critical, and a one-inch change in the clamp setting will shift the VSWR curve approximately 80 kHz. Be sure to loosen the clamp around tube E that supports the 30 meter assembly and to reposition it as needed to avoid distorting the 40 meter coil.

3. Check VSWR on 20 meters. Tuning is quite broad on this band because the antenna is physically much taller than a quarter wavelength. To raise the frequency of lowest VSWR, reposition the 30 meter assembly so that the L-clamp can be replaced on the next-lower turn of the 40 meter coil (refer to step 27 in the assembly instructions). Alternatively, to lower the frequency of lowest SWR, reconnect the L-clamp to the next-higher turn of the 40 meter coil. In some cases, moving the tap point a full turn up or down may cause more of a frequency shift than is desired, in which case the entire 30 meter assembly may be rotated around tube E to permit adjustments of less than one full turn.

4. Check VSWR on 15 meters. The VSWR curve may be shifted upward or downward by changing the length of the stranded wire between clamps L and K. To raise the frequency, simply shorten the wire by wrapping a longer "tail" back on itself and sliding the lower clamp upward to maintain tension. To lower frequency, feed more of the "tail" back through the hole in the insulator to increase the length of the wire between clamps L and K. A change of 2 inches (5 cm.) will shift the VSWR curve approximately 300 kHz.

5. Check VSWR on 10 meters. To raise the resonant frequency loosen the small hose clamp over the slotted end of tube I and slide tube J farther into tube I; to lower the frequency, slide tube J farther out of tube I and retighten the hose clamp. A length change of 3 inches should move the VSWR curve approximately 200 kHz.

6. Check VSWR on 30 meters. To raise frequency, loosen the

wing nut on the bottom coil clamp of coil P, stretch the coil and retighten the wing nut. To lower frequency, compress the coil. A change of only 1/4" will shift the VSWR curve approximately 100 kHz. Large changes in the setting of coil P may affect 20 and 40 meter tuning, in which case it may be necessary to repeat steps 2 and 3. In general, the point at which the 30 meter coil taps on to the 40 meter coil will be the major factor in 20 meter tuning.

7. Adjustments for 40, 30, 20, 15 and 10 meters should have little or no effect on the previous adjustments for 80/75 meters, but a final VSWR check for this band should be made as in step 1 above.

8. In above-ground installations it will usually be found that resonance and lowest VSWR occur at slightly higher frequencies on all bands compared to ground-level installations. Therefore, on 15 and 10 meters, where length adjustment is the means of setting antenna resonance, it is recommeded that the length of the stranded-wire between clamps L and K be increased approximately 3 inches (7.5 cm.) and that tube J be extended approximately 6 inches (15 cm.) beyond the original dimensions given if an above-ground installation is contemplated. These are merely recommended preliminary settings, for it is impossible to indicate precise settings that will produce resonance or lowest VSWR at a given frequency in all installations.

In the preceding steps it has been assumed that the antenna has been installed in a more or less clear spot away from other vertical conductors such as TV antenna feedlines, towers and masts, and that a minimal ground system (or a system of resonant radials in the case of above-ground installations) has been installed. If these fairly basic conditions have not been met it is likely that resonance and low-VSWR will be impossible on some or even all bands. One should bear in mind that VSWR, even with a resonant antenna, will depend in large measure on local ground conductivity, height above ground in the case of an elevated antenna, the extent of the radial, counterpoise or other ground system used, and on other factors over which the operator may have little or no control. Fortunately, the evils of VSWR greater than unity have been grossly exaggerated in recent decades, and the only practical difference between a VSWR of unity and one of, say, 3:1 in the average case lies in the reluctance of modern equipment to deliver full power into lines operating at the higher VSWR without the help of a transmatch or other outboard matching device. Transmitters having so-called broadband solid-state output circuits (no tuning or loading controls) may be especially troublesome in this regard, whereas the older vacuum tube pi-network transmitters can usually be adjusted for maximum output over a tuning range where the VSWR does not exceed 2:1.

THEORY OF OPERATION

The HF6V operates as a slightly extended quarter-wave radiator on 15 meters, a quarter-wave stub decoupler providing practically lossless isolation of the upper half of the antenna on that band. On 20 meters the entire radiator operates as a 3/8-wave vertical with much higher radiation resistance and VSWR bandwidth than conventional or "trapped" antennas having a physical height of one quarter wave or less. On 10 meters the HF6V becomes a 3/4-wave radiator with considerably greater radiation resistance and efficiency than quarter-wave trapped types. On 40 and 80/75 meters the L-C circuits that provided the inductive reactance for resonance on those bands also provide the capacitive reactance required for resonance on 20 meters. On 30 meters, where the height of the HF6V is slightly greater than a quarter wavelength, an additional L-C series circuit effectively "shorts out" a portion of the 40 meter inductor to provide an additional resonance. In order to minimize conductor and I^2R losses on 80 and 40 meters where the antenna is physically shorter than a quarter wavelength and thus operates with lower values of radiation resistance, large-diameter self-supporting inductors and low-loss ceramic capacitors are employed. Because the 20 meter radiation resistance will be several times as great as that of conventional vertical antennas, an electrical quarter-wavelength section of 75-ohm cable is used as a "geometric mean" transformer to match the 100-odd ohms of feedpoint impedance on that band to a 50-ohm main transmission line of any convenient length.

ELECTRICAL AND MECHANICAL SPECIFICATIONS

Shipping weight: 12 lbs/5.4 kg.
Height (adjustable): 26 ft./7.8 m.
Feedpoint impedance: nominal 50 ohms with included matching section
VSWR at resonance: 1.5:1 or less all bands
Bandwidth for VSWR of 2:1 or less: entire 10, 15, 20, 30 meter bands; 250-300 kHz 40 meters, 30-90 kHz 80/75 meters
Power rating: 2KW PEP/1 KW c.w. 80/75, 40, 20, 15, 10 meters; 500 watts PEP/ 300 watts c.w. 30 meters
Wind loading area: 1.5 sq. ft./.15 sq. m.

GUYING

The HF6V is designed to survive winds of up to 80 m.p.h./125 k.p.h. without guying in the absence of ice loading or heavy precipitation, but over a period of time it is to be expected that frequent or even constant flexing or vibration will reduce the chances for survival in winds that would not damage a newly-installed antenna. Therefore, in areas of frequent or heavy winds a set of short non-conductive guys should be used to reduce the stresses that wind loading will impart to the lower sections of the antenna. In this connection, it should be noted that

light nylon twine is totally unsuitable as guying material because it has too much stretch per unit length, although the heavier sizes of nylon rope (or even sash cord) may be suitable if used in short runs. Polyethylene rope may be used, but because some grades tend to deteriorate fairly rapidly, periodic inspections should be made. A *single* set of guys placed just above the 30 meter circuit will contribute greatly to the stability and the longevity of the antenna, provided that the guys retain a slight amount of slack and do not come off at too steep an angle. At angles of less than 45° the guys begin to exert a downward compressive force on the structure that can be more of a threat to survival than lateral wind loading on an unguyed structure. Under no circumstances should guys be placed higher than one-third of the way up the antenna. The upper two-thirds of the HF6V has little more than its own weight to support, so these sections may be allowed to bend with the wind with no serious risk of damage. It is the lower third of the antenna that must support both the weight of the upper sections and the wind loading on them and are thus more likely to receive damage in severe winds.

NOTE: A small packet of anti-seize/anti-oxide compound ("Butter-It's-Not"™) will be found inside mounting post A. This compound should be applied *lightly* to each tubing joint and to the inside of all clamps that must make good electrical contact with the tubing sections.

A small roll of weatherproof sealing tape ("Konnektor-Kote"™) is also provided. This may be used to seal the outside of the r.f. connectors that join the 75-ohm matching line (R) to the main transmission line for the antenna.

NOTES ON GROUND/RADIAL SYSTEMS FOR VERTICAL ANTENNAS

GROUND MOUNTING:

A vertical antenna in its simplest form is electrically equivalent to one-half of a dipole antenna stood on end. When the antenna is mounted close to the ground, the earth below takes the place of the "missing" half of the dipole. If ground conductivity is fair to good, a short metal stake or rod may provide a sufficiently good ground connection for resonant and low SWR operation on the bands for which the antenna is designed. This basic arrangement is shown in figure one. In almost every case, however, the efficiency of a vertical antenna will be greater if radial wires are used to improve ground conductivity as in figure two. Wire size is unimportant, and, in most ground-mounted installations, the radials may be any convenient length. They need not all be the same length, nor do they all need to be laid in a straight line. It is generally more convenient to slit the sod and to push the radials into the slits to a depth of several inches, but they may be left on the surface of the ground if they do not constitute a hazard. A large number of long radials will naturally be more effective in reducing ground losses than a small number of shorter ones, but one should remember that the greatest loss will occur in the earth near the base of the antenna where current flow is greatest. For this reason, it is generally better to use a larger number of radials of shorter length than a smaller number of longer ones for a given amount of wire.

In some cases wire mesh (e.g., "chicken wire") may be used as a substitute for radial wires and/or a ground connection, the mesh or screen acting as one plate of a capacitor to provide coupling to the earth beneath the antenna.

It should be noted that A GROUND ROD IS USEFUL ONLY AS A DC GROUND OR AS A TIE POINT FOR RADIALS. IT DOES NOTHING TO REDUCE RF GROUND LOSSES, REGARDLESS OF HOW FAR IT GOES INTO THE GROUND!

ABOVE GROUND MOUNTING:

It is possible to operate a vertical antenna at any height above ground provided that something be done to supply the equivalent of a ground connection. It is NOT ENOUGH TO RUN A LONG LEAD TO A GROUND STAKE OR COLD WATER PIPE, for current will flow in the lead, making it part of the overall antenna length and detuning the antenna on one or more bands. The usual approach to this problem is to install 3 or 4 resonant quarter-wave radials at the base of an elevated vertical and to connect them to the braid of the coaxial feedline as well as to the supporting mast or tower (if metal). Unlike the ground-mounted case, the length of above-ground radials is important, and the proper length(s) for any band may be found from the formula:

$$\text{Length (ft.)} = \frac{240}{\text{Frequency in Mhz}}$$

Four such radials, equally spaced, would be the equivalent of a highly conductive ground plane for any band at antenna base heights of one-half wavelength or more. In addition to providing a ground plane, radials of the proper length act as decoupling stubs to choke off current flow on any DC ground lead or grounded mast or tower, thus eliminating the detuning effect noted above. The basic ground plane system is shown in figure three. Radials may be run parallel to the earth or sloped downward any convenient amount without seriously affecting antenna feedpoint impedance or performance. Figure four shows a multi- band system using a separate set of radials for 40, 20, and 10 meters. Inasmuch as the 40 meter radials are also resonant on 15 meters, a separate set is not required for that band. This same system will provide enough capacitive coupling to ground for operation on 75/80 meters at antenna base heights below about 40 feet in some cases. But since ground conditions vary widely, it is advisable [illegible] use at least one resonant 80 meter radial in an [illegible] ground installation.

Figure five shows a simpler system which uses a single resonant radial for 80/75, 40, 30, 20, 17, 12, and 10 meters. With this arrangement, the antenna resembles a bent dipole on any one band, and the radiation pattern contains both horizontal and vertical componants. The system in figure four, however, produces omnidirectional vertically polarized radiation. (Note: 30, 17, and 12 meter radials are not shown, but may be included in this type of system.)

Figure six illustrates the construction of a multiband radial which is resonant on 40, 20, 15, and 10 meters. Good quality 300 ohm TV ribbon lead should be used (velocity factor is critical), and the conductors should employ at least one strand of steel wire to support the weight of the radial. Four such radials will be the practical equivalent of the system shown in figure four for operation on 80 through 10 meters.

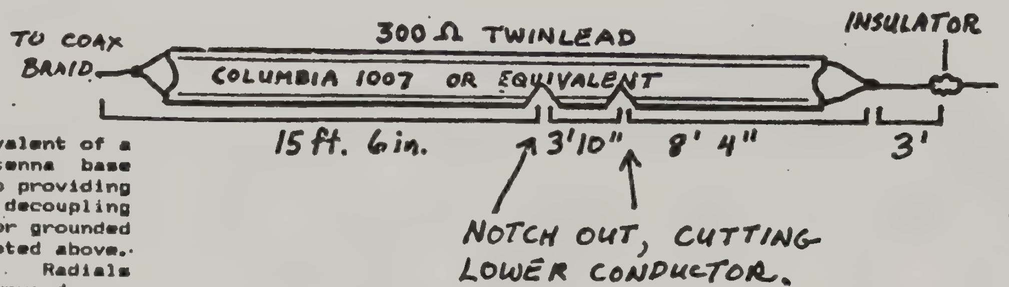
Regardless of the specific system used, radials should be well-insulated at their far ends and kept well clear of large masses of metal or other conductors that could cause detuning.

OTHER MOUNTING SCHEMES:

In cases where a resonant vertical antenna may be neither ground mounted nor used with an elevated ground plane, operation may still be possible if connection may be made to a large mass of metal that is directly or capacitively coupled to ground, e.g., central air conditioning systems or structural steel frames of apartment buildings. Some amateurs have reported good results with vertical antennas extended horizontally or semi-vertically from metal terraces which serve as the ground connection. Alternatively, a quarter-wave vertical may be window-mounted if a short ground lead to a cold water pipe or radiator can be used. If a long lead must be used, tuned radials will be required for resonance on one or more bands. GREAT CARE SHOULD BE EXERCISED IN SUCH INSTALLATIONS TO AVOID POWER LINES AND TO KEEP THE ANTENNA FROM FALLING ONTO PERSONS OR PROPERTY.

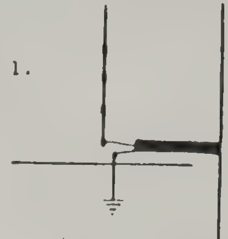
The metal shells of camper trailers, vans, and mobile homes may also be used as ground systems for vertical antennas. Whenever possible, the antenna should be mounted with its base close to the top of the roof, and the shortest possible ground lead should be used. Even so, tuned radials may be required for low SWR on one or more bands.

FIG. 6


TO COAX BRAID
300 Ω TWINLEAD
COLUMBIA 1007 OR EQUIVALENT
INSULATOR
15 ft. 6 in.
3'10"
8' 4"
3'
NOTCH OUT, CUTTING LOWER CONDUCTOR.

BELDEN 8230 MAY BE USED.

1.



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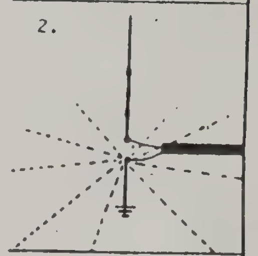

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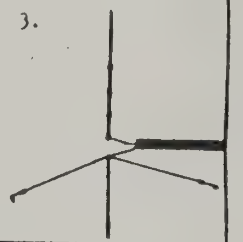
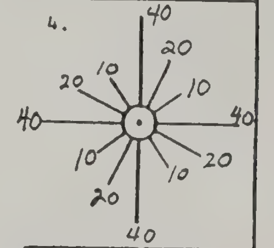


4.



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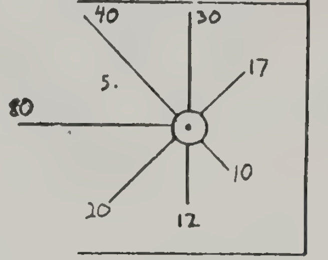
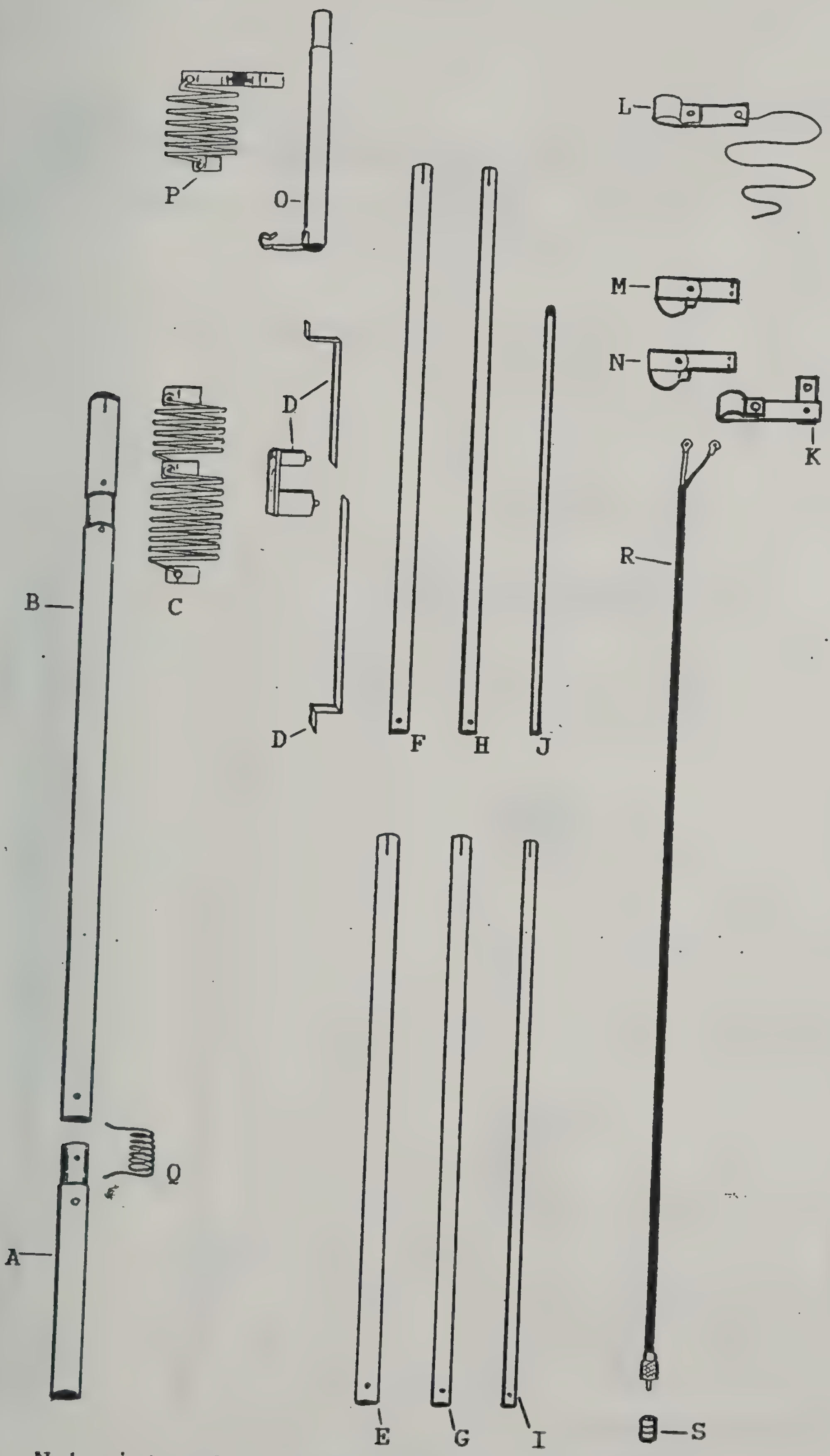




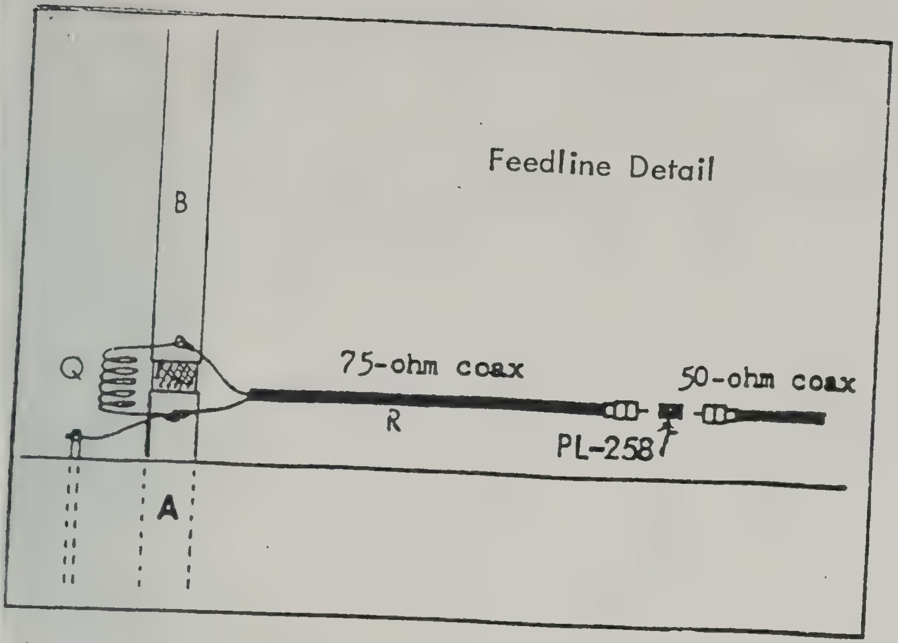
Not pictured: Packet of anti-oxide compound.
Weatherproof connector sealant.
(See page 11.)

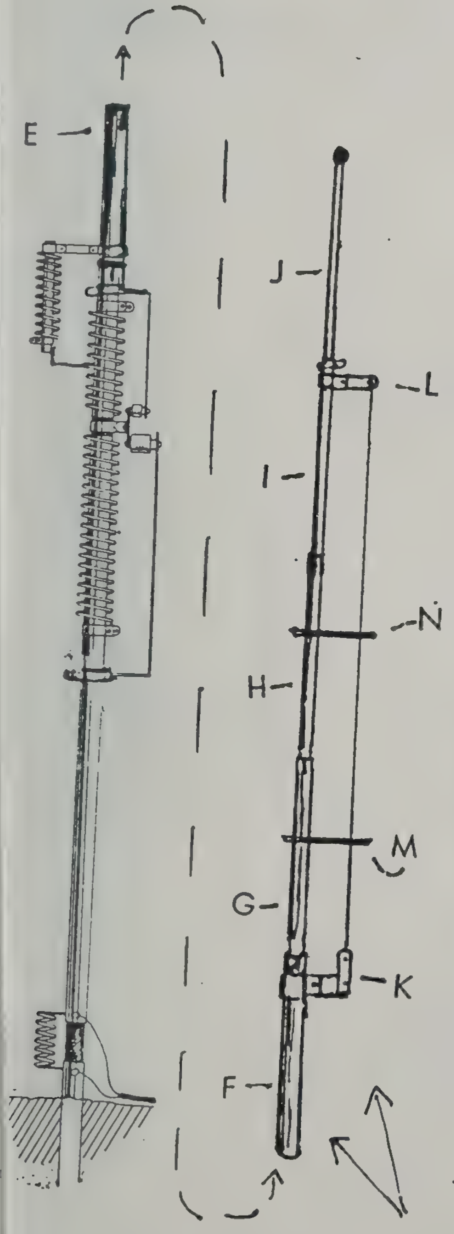
PARTS LIST

A. Mounting post & Insulator
B. Antenna Base Section & Center Insulator Rod
C. 80 & 40 M Coil Assembly
D. 80 & 40 M Capacitor & Bracket Assembly
E. Tube, 1" x 4 ft.
F. " 7/8" x 4 ft.
G. " 3/4" x 4 ft.
H. " 5/8" x 4 ft.
I. " 1/2" x 4 ft.
J. " 3/8" x 3 ft.
K. Clamp (7/8") with Insulator
L. Clamp (1/2") with Twisted Wire
M. (5/8") Clamp and Spacer
N. (3/4") Clamp and Spacer
O. 30 M Mounting Tube & "L"-Bracket
P. 30 M Coil & Capacitor Assembly
Q. Base Matching/Grounding Coil
R. 75-ohm Matching Line
S. PL-258 ("Barrel") Connector

HARDWARE

#8 (Small)	Qty
3/4" bolt	4
1" bolt	4
1-1/4" bolt	2
1-1/2" bolt	1
2" bolt	1
Flat washers	4
Lock washers	14
Hex nuts	14
#10 (Large)	
1" bolt	1
Flat washers	1
Lock washers	7
Hex nuts	3
Wing nuts	4
Compression Clamps	
Large	2
Small (adjustable)	1



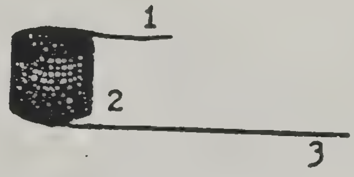


15 Meter Stub
Detail (not to scale)

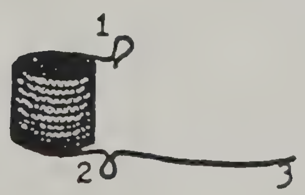
PICTORIAL PAGE

NOTE: *USE ANTI-OXIDE COMPOUND DURING ASSEMBLY!!! SEE PAGE 11.*

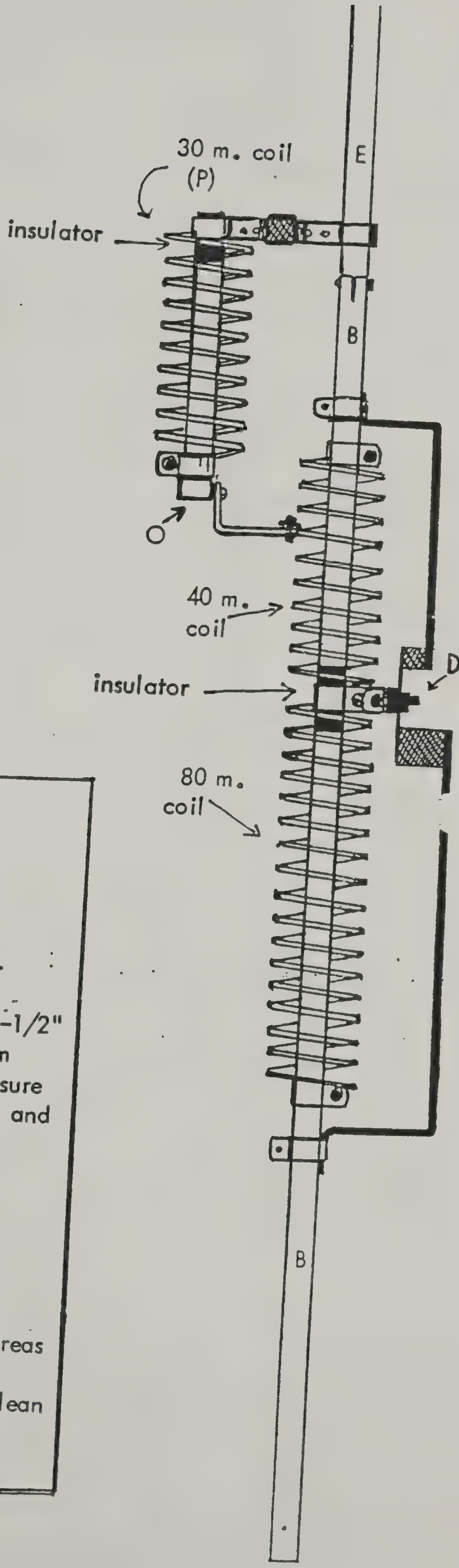
Preparing Coil (Q).



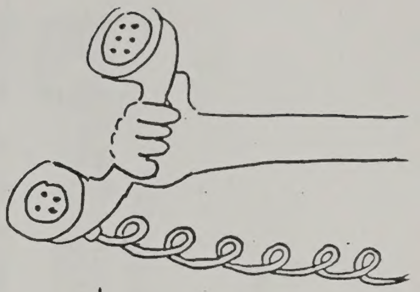
1. Use a knife to scrape 1-1/2" of enamel insulation from points 1, 2, and 3. Be sure that the copper is bright and clean.



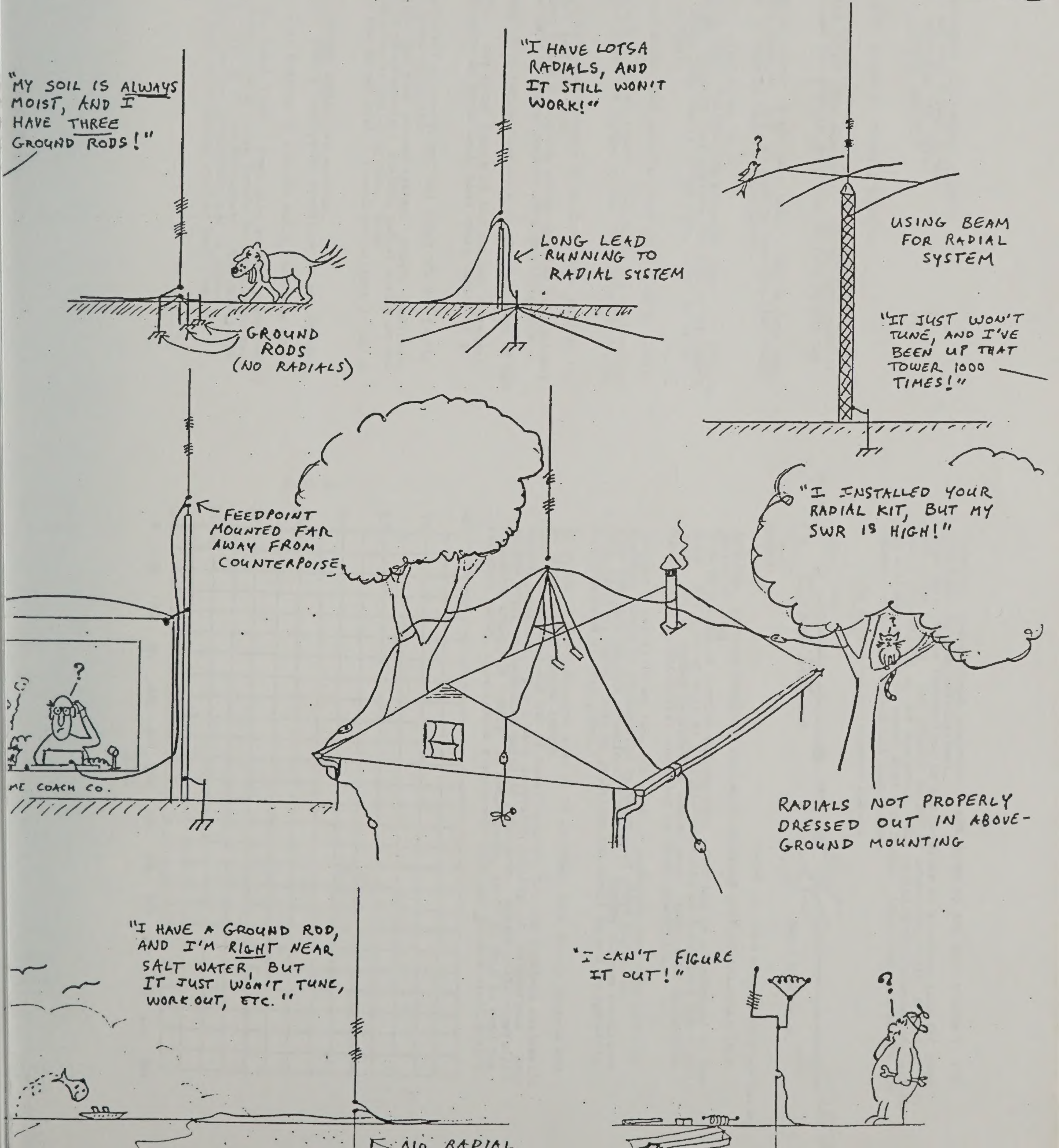
2. Bend two of the clean areas (1 and 2) into loops for connection later. The clean areas may be tinned with solder.



Before you call us



① FOLLOW THE INSTALLATION INSTRUCTIONS
② TUNE CAREFULLY & SYSTEMATICALLY
③ MAKE SWR CURVES
④ BE PREPARED TO DESCRIBE YOUR INSTALLATION


"MY SOIL IS ALWAYS MOIST, AND I HAVE THREE GROUND RODS!"
GROUND RODS (NO RADIALS)
"I HAVE LOTSA RADIALS, AND IT STILL WON'T WORK!"
LONG LEAD RUNNING TO RADIAL SYSTEM
?
USING BEAM FOR RADIAL SYSTEM
"IT JUST WON'T TUNE, AND I'VE BEEN UP THAT TOWER 1000 TIMES!"
FEEDPOINT MOUNTED FAR AWAY FROM COUNTERPOISE
?
ME COACH CO.
"I INSTALLED YOUR RADIAL KIT, BUT MY SWR IS HIGH!"
?
RADIALS NOT PROPERLY DRESSED OUT IN ABOVE-GROUND MOUNTING
"I HAVE A GROUND ROD, AND I'M RIGHT NEAR SALT WATER, BUT IT JUST WON'T TUNE, WORK OUT, ETC."
NO RADIAL
"I CAN'T FIGURE IT OUT!"
?

BUTTERNUT ELECTRONICS COMPANY
405 East Market Street
Lockhart, TX 78644
(512) 398-7117

IF YOU HAVE PROBLEMS...

Check over your installation again. Be honest, now! Did you *really* read the instructions and follow them carefully? Are all your connections tight? OK? Then use the *SYMPTOM* list below to help locate the problem.

Symptom: Few or no signals heard; bands seem 'dead', SWR is very high.
Look for: Open or shorted feedline, open or shorted matching line (when used), broken connection at base of antenna (feedpoint).

Symptom: High SWR on 20m; other bands OK.
Look for: Missing matching line. Antenna not properly tuned. 20m radials not present or wrong length. Consult instructions for tuning and radial information; install matching line (RG-11 75 ohm coax, 11'4" if solid dielectric, 13'6" if foam type).

Symptom: High SWR on some bands, but signals heard on all bands (conditions permitting).
Look for: Missing or defective radial system. Install as per instructions and check connections to radials and ground system. Keep this connection 6 *inches* or less.

Symptom: High SWR on one band when antenna is roof-mounted. Radials are in place, but antenna will just not tune.
Look for: Radials of wrong length or running close to metal rain gutters or roof flashings. Tune radials and/or reroute them away from metal.

Symptom: Tuning is 'sharp' with narrow bandwidth on 80m (and 160m if TBR 160 is in place).
Look for: Normal condition. The total length of the antenna represents such a small % of a wavelength on these bands that sharp tuning is a normal condition.

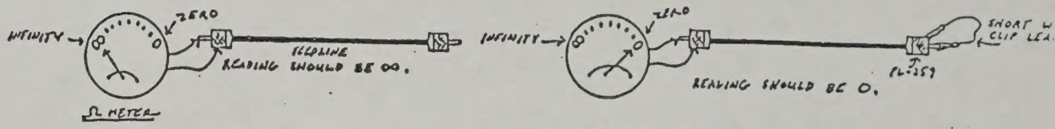
Symptom: Antenna was installed on the ground and tuned OK, but tuning changed over a period of weeks or months.
Look for: Antenna installed over poor ground system. Ground conditions have changed, causing shift in resonance. Install radial system as per instructions. Check connection to radial system. When you see this problem, you may assume that a ground rod without a radial system is not enough.

Symptom: Resonant point changes during wet weather.
Look for: Normal condition. Reduce high power operation in wet weather.

Symptom: Insulation arcs over between 80 and 40m coils, damaging the fiberglass.
Look for: Operation over the legal limit. Operation at high power levels during wet weather. Operation at high power levels in areas where salt or pollution deposits have built up on the insulators. The cure is to keep insulators clean through routine maintenance and to depend on operating skill instead of high power during adverse conditions.

Symptom: Intermittent operation. SWR jumps up and down suddenly, and reception is also intermittent.
Look for: Loose connections in the feedline or matching line (if used). Bad relay in rig Bad antenna switch or connecting cable. Broken or corroded connections at the feedpoint. Bad radial/ground connection. Radial or antenna contacting metal when wind blows. Loose hardware on the antenna. Check and secure all connections.

Open or shorted feedline or connectors--Check with ohm meter.



Coax OK? No: Repair or replace, then retest until OK.

Symptom: Antenna displays generally degraded performance after long period of time.
Look for: Lack of routine maintenance. Coax may be waterlogged or damaged. Build up of salt or pollution deposits on insulators and capacitors. Radial system corroded or rotted away. Owner must do routine maintenance at intervals, according to local conditions.

Symptom: SWR is OK on 75m, but goes up gradually when high power is applied. This is accompanied by heating of 200pF capacitor.
Look for: Bad ceramic capacitor. Replace. During adverse conditions (wet weather, icing, salt or pollution build-up) depend on operating skill instead of high power.

Symptom: Antenna doesn't tune on 80 or 160m, even though radials are in place and of proper length.
Look for: Antenna far out of tune; operator has not followed systematic tuning procedure. Start with suggested settings in instructions. Make an SWR chart to determine point of resonance. Adjust coils *carefully!* Remember, tuning is 'sharp' on these bands, so it is easy to pass the resonant point, then assume erroniously that the antenna isn't tuning.